SURGERY, GYNECOLOGY AND OBSTETRICS

AN INTERNATIONAL MAGAZINE, PUBLISHED MONTHLY

VOLUME LII FEBRUARY, 1931 NUMBER 2

EXPERIENCES WITH THE CEREBELLAR ASTROCYTOMAS[1]

A CRITICAL REVIEW OF SEVENTY-SIX CASES

HARVEY CUSHING, M.D., BOSTON

I. INTRODUCTION

WHAT has been chiefly contributory in recent years to the success of operations for intracranial tumors has been the tendency of those interested in the subject to concentrate upon the behaviour and traits of special tumors in special situations. This was hardly possible when these operations were few and far between, but now that they are of daily occurrence it becomes increasingly evident that tumors of each particular kind occupy favoured sites and evoke a similar and therefore recognizable set of symptoms. This being so, it becomes possible with some degree of assurance to foretell in a large percentage of cases what particular type of lesion will be encountered, what it will look like when brought to view, and what surgical procedure offers the best prospect not only of the immediate amelioration of symptoms, but, in an ever enlarging percentage of cases, of permanent cure.

As an outcome of this change in attitude and with the growing conviction that the point of origin of tumors of different kinds is not purely accidental, it is no longer highly profitable to discuss the effects of brain tumors in general, to describe the symptomatology of tumors in a given region irrespective of their specific nature, or to deal with tumors of comparable histology irrespective of their location.

For this reason, those of us who have been at this business longer than others begin to feel the obligation of handing on from time to time the results of our surgical experience with tumors of particular kinds in particular situations. This sort of information, however, is admittedly difficult to transmit, for though the general principles may be more or less the same, no two of these operations are precisely alike, and in the process of carrying out what at the best is a complicated and often hazardous procedure, unforeseen circumstances may arise which wholly modify its intended course. When to take great risks; when to withdraw in the face of unexpected difficulties; whether to force an attempted enucleation of a pathologically favourable tumor to its completion with the prospect of an operative fatality, or to abandon the procedure short of completeness with the certainty that after months or years even greater risks may have to be faced at a subsequent session—all this takes surgical judgment which is a matter of long experience and which can scarcely be transmitted by the written word.

Surgical judgment, indeed, is a more or less inspirational quality which is variable and elusive, all surgeons being conscious of having it in hand on some occasions, of losing it on others. It is a good deal like a game which even the best and most consistent player foozles for some unaccountable reason at

[1] Being the basis of the second Arthur Dean Bevan Lecture of the Chicago Surgical Society delivered October 3, 1930, before the joint meeting of the Chicago Surgical Society, the Institute of Medicine of Chicago, Chicago Neurological Society, the Society of Internal Medicine, the Chicago Pediatric Society, and the Chicago Society of Medical History.

certain times. The surgery of brain tumors may be likened without being trivial to a form of major sport which is played against an invisible but utterly relentless antagonist quick to take advantage of every misplay and faulty move. And when the time comes to make public one's score, it is done somewhat apologetically, but with the expectation that others may profit by it and with the assurance they will come to improve upon it.

The gliomas in general. All this applies with particular force to the formidable tumors composed of the structural elements of the central nervous system, once looked upon as invariably malignant lesions with a hopeless prognosis. Operative interference was commonly supposed to activate a tumor of this kind and for long the general tendency among surgeons was to leave a glioma, once exposed, respectfully alone. Nor was any encouragement to be had from the standpoint of the pathologist. There is no better contemporary description of the histological peculiarities of the gliomas as a class than the vivid though brief account written by W. T. Councilman in 1915 shortly after the opening of the Brigham Hospital and based on the 115 tumor specimens that had already passed through his hands (1). Not only did he find the lesions hopelessly infiltrative, but so great was their architectural and cytological variation from tumor to tumor—indeed in different parts of the same tumor—that any attempt at classification, which would even serve a convenient purpose, was then looked upon as futile. And when as time passed it came to be appreciated that the gliomas represent something over forty per cent of all intracranial neoplasms, this was taken to mean that approximately half of the surgeon's time, if given over to the treatment of lesions of this kind, would necessarily be devoted to the disheartening occupation of affording at best but temporary relief from tumors that were essentially inoperable.

Thus, neither pathologist nor surgeon, acting independently, could feel anything but discouragement when confronted by new-growths whose behaviour and microscopic appearance were so in accord with the tradition of high malignancy. However, as time went on and cases were followed to their end, it became increasingly clear, from the unexpected longevity shown by patients with verified gliomas, that there must be a number of relatively benign varieties favourable for surgical removal provided operative methods could be evolved for their exposure and enucleation. To bring some possible order out of this chaos, during the past several years, as may be known, my co-workers and I have been engaged in the attempt to classify the gliomas in our collection on the basis of their life history and behaviour taken in conjunction with their histogenesis—a task in which Dr. Bailey played a highly important contributory rôle.

Particular gliomas. Meanwhile, the gross appearance of these tumors as they are encountered at the operating table with the details of the preferential surgical treatment that has been in course of development, has received but little emphasis. It is high time that these wants, for the several now well recognized types of glioma, should be more fully met.

In an address a year ago before the Medical Society of Lund (2), a detailed account was given of our surgical experiences with what, from a therapeutic standpoint, are the most unpromising of all the gliomas—the medulloblastomas. These highly malignant tumors which are particularly common in childhood, which in the majority of instances take their origin from the roof-plate of the fourth ventricle, and which tend to widespread transplantation through inoculation of the cerebro-spinal spaces, prove, in the present state of our knowledge, to be therapeutically the most baffling of all gliomas. In whatsoever way they have been treated, whether by decompression alone or by radical extirpation combined with radiation, recurrence of symptoms from continuance and rapid spread of the growth has been inevitable; and though temporarily brilliant results have amply justified the labor spent upon them, the longest period of survival in any one case was five years. Embarrassing as it was to prepare and publish the report of the sixty-one examples of these tumors in which the operative mortality had been higher than for any other form of intracranial neoplasm, it seemed necessary to do so

for the purpose of focusing attention upon them. We now know, at least, what we are dealing with and that is more than could be said of these tumors ten years ago.

In the concluding paragraph of that address, I expressed the hope that some day the far more agreeable task might be undertaken of preparing a comparable survey of another group of gliomatous tumors that show a comparable predilection for the same mid-cerebellar region of childhood but have a far more favourable prognosis. I propose to take advantage of the present opportunity to do so.

Cerebellar astrocytomas: early experiences. The tumors to which I refer belong to that nebulous group of lesions formerly spoken of as gliomatous cysts which now prove to have a neoplastic basis composed of highly differentiated neuroglial cells known as astrocytes. Step by step, we have come to learn enough of their histogenesis and behaviour to know how they should properly be treated, but it has been a slow and painful process like feeling one's way in a fog. I see no better way of showing what obscurities once beset us than by describing my first experiences with the few cerebellar tumors operated upon between 1908 and 1912 which now prove to have been of this type. They begin the series of seventy-six examples (cf. Table) which my associate, Dr. Eisenhardt, and I have taken the trouble, for the purpose of this report, histologically to restudy and reverify.

As was inevitable, this temporary concentration upon tumors of a single type with the painstaking re-examination of all the tissues has proved to be highly informing. By giving us a much clearer mental picture of the histological architecture of the astrocytomas as a group than we previously were able to carry when from day to day and week to week we were examining gliomas of varied structure, behaviour and location, it has enabled us to correct a number of erroneous diagnoses that had crept into our previous lists. At the same time, and what is more important, it has forced us to conclude, as will be told, that the attempted separation, at least of the cerebellar astrocytomas, into two types, protoplasmic and fibrillary, may for all practical purposes be abandoned; for most of the tumors prove to be composed of both elements and their natural history is the same whether the lesion is predominantly fibrillary or predominantly protoplasmic.

One outcome of this critical revision of the tissues has been the discovery among our recorded cerebellar astrocytomas of three cystic tumors with an unquestionable hæmangioblastic basis, two of which had been overlooked when these particular lesions were recently made the subject of a detailed report (3). These blood-vessel tumors, all or most of which in years gone by received a pathological diagnosis of "angiomatous" gliomas, are commonly, perhaps invariably, cerebellar lesions and have a life history closely resembling that of the cystic astrocytomas of the region. Partly for this reason, partly because we had not as yet found how positively to distinguish them from the gliomas, partly because they are apt to produce a reactive gliosis in the adjacent nervous tissues, these three examples came to be erroneously classified as fibrillary astrocytomas, and were never subsequently detected. As a matter of fact, the very case that would otherwise have served to lead off this present series now appears to us to have been so misjudged. The story follows:

It was that of a young man named Milton Ferguson, well known to a succession of my assistants, who when eight years of age was first operated upon in March of 1907 at the Johns Hopkins Hospital at which time no cerebellar lesion was detected. At a second operation in June, 1908, a cerebellar cyst ("degenerated glioma") was found and evacuated. Seven years later at the Brigham Hospital in July, 1915, owing to recurrence of symptoms, the cyst was re-exposed and its wall thoroughly puckered by formalin fixation. A fourth operation (at other hands) was made in June, 1918, when a supposedly inoperable glioma was disclosed. A year later, in May, 1919, at a fifth operation, the cyst was found to be largely replaced by a tumor mass which was partly removed and diagnosed, interestingly enough, as "neuroglial granulation tissue." A sixth operation was called for six years later, in April, 1925, when a radical extirpation of the recurrent growth was undertaken and presumably because of a reactive gliosis it was mistaken for a fibrillary astrocytoma. The patient though nearly blind at the time of the first operation is still living, well, and self-supporting, now twenty-three years later. This long survival period was entirely compatible with the behaviour of an astrocytoma but on further

study of the tissue this diagnosis appears to us to lie open to such doubt that we feel obliged reluctantly to exclude the case from our revised list.

It is proper openly to face this apparent blunder for the reason that this particular case has crept into the literature of the gliomas and has been alluded to (its original Johns Hopkins Hospital Surgical Number 20433 serves to identify it) on a number of occasions—from the standpoint of the cyst (4), from the standpoint of calcification in slowly growing gliomas (5), from the standpoint of cerebellar tumors in childhood (6), and as an example of a fibrillary astrocytoma (7). The admission of a probable diagnostic error in this case points its own lesson and at the same time gives the opportunity to call attention to the similarity in the life history of a cerebellar angioblastoma and astrocytoma to which there will be occasion to return in considering the differential diagnosis.

In 1907 when this Ferguson boy first came under observation, brain cysts containing yellow fluid were usually looked upon in accordance with the belief of Sir Victor Horsley as degenerated gliomas. That these xanthochromic cysts were invariably associated with a mural tumor was unknown or was unappreciated, and the fact that the cyst encountered at the second operation would be found eight years later to have become largely replaced by a solid growth was wholly unforeseen. Emphasis, in other words, was laid in those days on the cyst rather than on the tumor that gave origin to it, and because the accumulated fluid was presumably secreted by the cyst wall, it was something to be destroyed or removed if possible. This, therefore, was the customary procedure, as exemplified by the first two cases in the series as now revised:

CASE 1. A physician's child under two years of age and supposedly rachitic had been under observation off and on during the year 1908 for a rapidly progressive hydrocephalus which had developed subsequent to a fall after an apparently normal first year of life. A series of combined ventricular and lumbar punctures led to the conclusion that there must be a mechanical block at the foramen of Magendie. The child gradually became bedridden, spastic, subject to convulsive (cerebellar) seizures, and an exploratory operation was finally deemed necessary.

Accordingly, under ether anæsthesia on April 29, 1909, the exploration was made and a huge mid-cerebellar cyst was disclosed. An attempt was made to dissect out the cyst wall (Fig. 1) but this had to be abandoned short of completion owing to the depth to which the cavity extended. The child did not long survive the operation, and at autopsy the deeper residual part of the cyst (Figs. 2 and 3) was found to be partly lined by a "gliomatous" tumor which when restudied in 1923 was recognized as an astrocytoma and classified as protoplasmic. Though predominantly so it nevertheless contains many scattered fibrils.

In the next case, in the process of extirpating the cyst a nodular mural tumor was at the same time accidentally removed. This was looked upon at the time as a matter of secondary interest rather than of primary importance and the favourable outcome was long ascribed to the eradication of the secreting cyst wall.

CASE 2. *Permanent cure of a gliomatous cerebellar cyst following a single operation at which a mural tumor-nodule was inadvertently removed in process of removing the cyst wall. Patient living and well after 21 years.*

April 1, 1909. Admission of Edward P., a carpenter 26 years of age, referred by Dr. J. G. Hopkins of New York with the complaint chiefly of headaches and loss of vision.

Anamnesis. For four years and perhaps longer, he had been having periodic headaches with blurring of vision and some slowly increasing unsteadiness in gait. He had been seen at the Johns Hopkins Dispensary in April, 1906, when a diagnosis of "nervous headaches" was made and he was fitted for glasses. In August, 1908, he began having periods of temporary amaurosis and his sight then failed rapidly. Eight weeks before admission an exploratory craniotomy with exposure of the left cerebral hemisphere with tapping and temporary drainage of the ventricle after disclosure of a hydrocephalus had been made in Brooklyn, New York.

Examination showed a young man with an advanced cerebellar syndrome and a small "riding" bone flap without decompression over the left side of the cranium. There was a choked disc of 7 diopters with secondary atrophy. Vision was reduced to light perception and the counting of fingers with occasional correctness. Some hypæsthesia of the right face and tinnitus in the right ear suggested a probable tumor of the right cerebellar recess.

Operation. April 14, 1909. Under ether the customary cerebellar exposure was made with bilateral flaps and removal of the posterior arch of the foramen magnum. A coincidental ventricular puncture was not yet a common practice and extracranial bleeding was difficult to control. On opening the dura the cerebellum extruded greatly and

marked foraminal herniation of the tonsils was present. Palpation revealed a soft area to the left of the midline. A needle was inserted and yellow, quickly clotting xanthochromic fluid was withdrawn. The effort, customary at the time, was then made to dissect out the cyst by brushing it away from the adjacent cerebellum. In this process a solid nodule of tumor the size of the terminal segment of the thumb was unexpectedly encountered and removed with the deeper part of the cyst wall. A portion of the tumor nodule which was firm and "gritty" was submitted to Dr. F. B. Mallory and termed a "psammomatous glioma" probably malignant in view of existent mitoses.

Subsequent course. Following this operation the patient made a speedy recovery. His cerebellar symptoms rapidly subsided and though the choked discs were not quite flat at the time of his dismissal on May 11, they were fortunately receding with retention of light perception. The patient subsequently learned broom-making at a school for the blind and this occupation has enabled him to marry and support his two children. He is now 47 years of age and writes that he works at his trade eight hours a day.

The fact that in the process of dissecting out this cyst a nodule of tumor was encountered and removed was regarded at the time as purely incidental. Indeed, when in 1923 Dr. Paul Martin (4) made an end-result study of the various xanthochromic cysts of the nervous system, all of which at that time were supposedly gliomatous, the relation of the tumor removal to the long survival period in this case was scarcely suspected.

When an experience such as this is now looked back upon, it seems that only stupidity could have so long delayed our better understanding of these lesions. Indeed, we did not hit upon the explanation of our many failures till fifteen years later, and then only because we began routinely to search for and to remove the mural tumors from all cysts largely to give us tissue for tumor classification. In partial extenuation, it must be recalled that the cases did not follow in sequence and between them many experiences of other kinds relating to other tumors intervened to obliterate their memory and obscure their significance. What is more, we of course could not foresee what had been accomplished for this patient and the immediate result was no better than would have been brought about by the less hazardous procedure of merely evacuating the cyst.

Fig. 1. (Case 1.) Photograph of portion of excised cyst wall spread over a ball of cotton to give its approximate size.

The third case in this early series was that of a child of six with an advanced cerebellar syndrome who was first operated upon in May, 1910, when a large xanthochromic cyst was merely tapped and evacuated. After a year's relief from symptoms a second operation by another surgeon disclosed a large gliomatous tumor which was partly removed, and after another interval of two years an attempt at my own hands to make a more radical extirpation led to opening of the fourth ventricle with subsequent fatality from meningitis.

The fourth case, which first came under observation in October, 1910, six months later than the preceding one, is as follows:

A boy nine years of age, blind on admission, gave a history of unsteadiness for a period of at least five years. At operation a marked pressure cone was disclosed but no tumor, punctures of the hemispheres being negative. The decompression gave relief for over a year when headaches and vomiting returned and at a second operation in January, 1912, a large median cyst was encountered and its wall partly removed. Two years later he was brought to the Brigham Hospital bedridden and having a succession of critical Jacksonian seizures. The unmistakably advanced cerebellar syndrome was complicated by coexistent signs of spinal paralysis suggesting tumor implantation. A third operation was undertaken, January 16, 1914, when underlying a superficial

Fig. 2. (Case 1.) Coronal section of the brain (⅜ nat. size) showing the marked hydrocephalus and the intact residual anterior portion of the cerebellar cyst (cf. Fig. 3). From the dorsal remnant of mural tumor indicated by the arrow a block has been cut out for histological verification. [Ref. p. 132.]

cyst a large, firm, median tumor projecting through the foramen magnum was uncovered. The attempted piece-meal extirpation of the growth was abandoned owing to the patient's condition. Death from respiratory failure soon followed and at postmortem examination the remaining portion of the growth was found capped by a concealed cyst (Fig. 4). There was a coincidental extensive syringomyelia of the cord accounting for the spinal paralysis.

The tumor, recognized as a glioma, was carefully described at the time by W. T. Councilman. It was restudied by Bailey in 1923 who regarded it as an astrocytoma of protoplasmic type and it is so classified in our monograph (3) though it contains many sparsely disposed fibrils.

The next case, the fifth in this original series, owing to the unusual premonitory history and prolonged interval of comparative relief following mere cyst evacuation merits reporting in some greater detail.

CASE 5. *Emergency puncture of cerebellar cyst following sudden respiratory failure. Removal of large mural nodule at operation 13 years later. Patient now symptom-free 32 years from probable onset of symptoms.*

October 22, 1911. Admission to the Johns Hopkins Hospital of Ora M., 17 years of age, referred by Dr. Charles E. Kahlke, of Chicago.

Emergency operation. The patient on reaching the hospital late in the evening was found to be in a critical condition, complaining of intense headache, highly restless, with a choked disc advanced to the stage of secondary atrophy. The anamnesis, sketchily secured from his attendant, strongly suggested a cerebellar tumor, and recognizing the urgency of the case it was being worked up as rapidly as possible. That a critical condition of this sort could be tided over by the intravenous administration of hypertonic salt solution was then unknown.

On the afternoon of October 23, while the preliminary neurological examination was being checked in the ward, the patient became cyanosed, developed Cheyne-Stokes respiration, had an agonal, copious

movement of the bowels and stopped breathing. Artificial respiration was immediately and successfully instituted. Acting on the inspiration that he might conceivably have a cerebellar cyst, he was transported by stretcher to the unfortunately distant operating room which was hurriedly prepared. There, face down on the cerebellar table in a position favourable for artificial respiration by Schafer's methods, after scant aseptic preparation a burr opening was made over the right cerebellar hemisphere and a needle introduced through the dura. A large xanthochromic cyst was struck, fluid spurting from the needle; spontaneous breathing was almost immediately resumed and an hour later the patient was responding to questions. The period of respiratory cessation had been almost precisely three quarters of an hour.

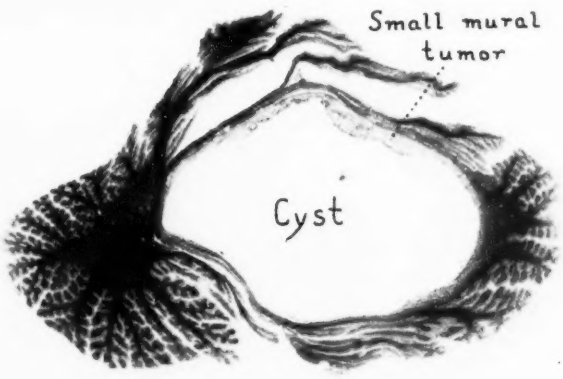


Fig. 3. (Case 1.) Photograph (nat. size) of a section through the entire cerebellum showing the situation and extent of the flat mural tumor variously diagnosed as degenerated glioma or congenital cyst (1909) and as protoplasmic astrocytoma (1923). It shows abundant fine fibrils. [Ref. p. 132.]

Anamnesis. This, as subsequently elicited in detail, served unquestionably to date the onset of symptoms from the spring of 1897 when at the age of four, after recovery from a prolonged attack of whooping cough, the boy was noticeably unsteady on his feet and during the remainder of the year had early morning attacks of occipital headache and vomiting. Associated with some of the more severe bouts of vomiting spasms occurred in which he would stiffen out. The attacks, which were regarded and treated as choreiform, recurred periodically during 1898 and 1899 alternating with intervals of a few months' duration in which there was symptomatic relief.

In the spring of 1900 the boy's head was observed to become unduly large, and there followed a period of five years during which, apart from some residual awkwardness of locomotion, he remained symptom-free. In 1906, however, headache and vomiting again appeared in much exaggerated form with marked ataxia and definite impairment of vision. Constipation, meanwhile, had become a most troublesome symptom, for the boy dreaded to evacuate his bowels as straining greatly increased his discomforts.

Following an operation of some sort at this time, the details of which remain unknown, there was again a period of relief so that for another five years in spite of occasional headaches, vomiting and persistent instability, he was fairly regular in his attendance at school. Two months before his hospital admission with some abruptness the symptoms had again suddenly become greatly increased with intense suboccipital headaches and such a degree of inco-ordination he was necessarily confined to bed.

Interval history. Following the emergency operation recounted above, there was a smooth convalescence marred only by prolonged hiccoughing. The cerebellar ataxia which at first was excessive soon subsided and at the time of his discharge on November 7 he was walking with support and in a fair way toward recovery from all symptoms apart from some impairment of vision.

He subsequently resumed his high school studies, caught up with his former class and graduated two years later. He then attended a teachers' institute and a letter of August, 1915, stated that he was teaching in a country school and that the summer before he had without the slightest fatigue climbed Pike's Peak one night to see the sun rise. His only handicap was some persistent ataxia of his right hand. A year later he went into business for himself as an apothecary.

In May, 1918, during the writer's absence in France, there was a temporary return of symptoms. He consulted a neuro-surgeon who on the basis of a right astereognosis advocated a cerebral exploration which the patient refused and the symptom spontaneously subsided. [Astereognosis in the right arm had been a feature of the case throughout. Its occurrence in association with cerebellar cysts has been covered in another connection (3).] Another attack more serious in nature occurred in December of 1922 at which time Dr. Kahlke re-evacuated the cyst. In September, 1924, owing to a return of pressure symptoms with increasing inco-ordination he again consulted Dr. Kahlke who after an ineffectual attempt again to tap the cyst referred him to the Brigham Hospital.

Admission. October 10, 1924. The patient at this time was suffering from severe occipital headaches, vertigo, hiccoughing and constipation. Examination showed a markedly staggering gait, nystagmus, ataxia, hypotonicity, right astereognosis, exaggerated deep reflexes, and choked discs.

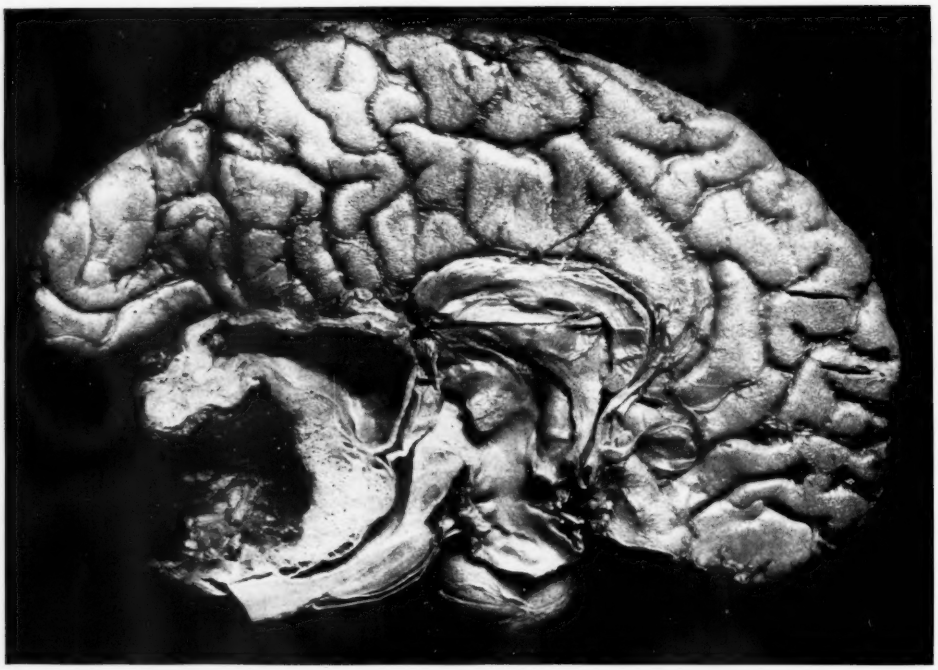


Fig. 4. (Case 4.) Mesial section of brain showing partially excavated astrocytoma capped by concealed cyst, the detection and evacuation of which might even in 1914 have made complete extirpation of growth possible and have forestalled fatality. [Ref. p. 134.]

Re-operation. On October 23, under ether anæsthesia, a proper bilateral exposure of the cerebellum was made for the first time. A huge, multilocular cyst holding *circa* 125 cubic centimeters of yellow clotting fluid was evacuated; a centrally placed mural nodule of hen's egg size (Fig. 5) was exposed and extirpated apparently in its totality. The tumor proved to be an astrocytoma of fibrillary type.

Postoperative course. Convalescence was somewhat stormy. There was fever and a succession of punctures were necessary to remove bloody cerebrospinal fluid. This was overcome and the patient was discharged on November 15 with all symptoms greatly improved. His letters during the subsequent six years repeat the statement that he had never known before what it was to feel really well, and he continues to conduct his business as an apothecary.

The notable feature of this story is the long antecedent history before the tumor reached the point of causing what might have been a fatality from medullary compression. Fourteen months rather than as many years would have been an over-long premonitory period for a medulloblastoma in the same situation. But of such matters we then knew nothing any more than we knew that the mere evacuation of the cyst would only serve to postpone the day when a radical attack on the underlying tumor would be necessary, a task much more easily accomplished at a primary session when the mural tumor, as it was in Case 3, might happen to be comparatively small. Unfortunately, however, the surgical problem is not always so simple as this proposal would imply, as is shown by the last of the six cases in this early series.

CASE 6. Ten years before entrance, when 13 years of age, the patient had been thrown from a mule striking the back of his head. He was knocked unconscious. Two years later, owing to posterior headaches and vomiting he was in a hospital for the better part of a year. Since that time, though never wholly free from symptoms he had managed to finish school and take up the trade of carpentry. Vision had been slowly failing and of late there had been

periods of temporary blindness. During the three weeks before admission he had been having a series of "spells" characterized by cyanosis and rigidity but without unconsciousness. Constipation had been a most troublesome symptom for many years.

Examination showed a bedfast and stuporous young man with a pulse of 60, complaining of intense headache. There was a bilateral advanced choked disc of 6 diopters with vision reduced to counting fingers; a bilateral abducens palsy; and nystagmus. Gait, station and inco-ordination were impossible to test. Neither deep nor superficial reflexes could be elicited.

A cerebellar tumor with secondary hydrocephalus was suspected but the patient's general condition was too critical to justify the prolonged inhalation narcosis necessarily employed in those days for a cerebellar exploration. It was thought diagnostic information might be gained and that benefit might follow a callosal puncture, a procedure which at the time was warmly advocated in some quarters. The puncture accordingly was made on April 29 with only temporary amelioration of the symptoms. Headache and vomiting in aggravated form soon returned; swallowing became impossible necessitating nasal feeding, and death with hyperthermia (108° F.) occurred on the eighth day.

The autopsy showed a hydrocephalic brain with a large, centrally placed multicystic cerebellar "glioma" inseparably incorporated with the brain stem (cf. Fig. 6).

The postmortem findings in this long neglected case would have been enough to discourage the most optimistic from undertaking an operation for any such tumor. That the surgical problem was in any way related to the preceding experiences, other than that the growth was one of the kaleidoscopic manifestations of gliomatous tumors in general, was not suspected. Yet could this growth have been attacked, as today, under local anæsthesia and its chief mass electrically removed with relief of the hydrocephalus and re-establishment of cerebrospinal fluid circulation, the patient might well enough still be alive.

Stages of classification. Taken by themselves and properly interpreted, the experience with these six cases from this original Baltimore series would tell almost all there is to be told about these cerebellar astrocytomas. They make it sufficiently clear that symptomatic indications of the disorder can be traced to childhood; that the lesions at the outset tend to be cystic; that symptomatic recurrence may be expected after mere cyst evacuation; that the cysts contain a mural tumor which

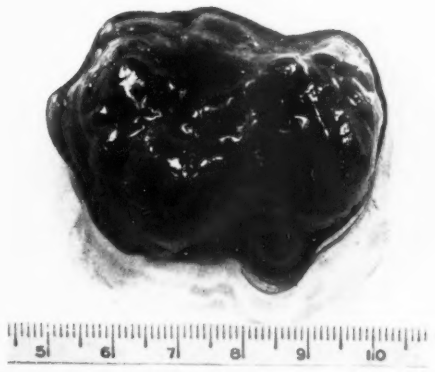


Fig. 5. (Case 5.) Photograph of wet-tissue nodule (nat. size) as removed at secondary operation.

may be expected to increase in size ultimately to fill and largely replace the cavity; that removal of the mural tumor nodule may result in cure which indicates that the xanthochromic fluid exudes from the surface of the tumor and not from the wall of the cyst proper.

But these interpretations are purely retrospective. The long survival periods of the favourable cases were wholly unforeseen and fifteen years were to elapse before we came to correlate the type of the glioma with its clinical prognosis. In our groping efforts, meanwhile, to find some convenient method of distinguishing between surgically favourable and unfavourable gliomas, we came to separate them into: (1) *gliomatous cysts*, when at operation the bulk of the space-occupying lesion was found to be cystic; (2) *cystic gliomas*, when a cyst-containing tumor was encountered; and (3) *non-cystic gliomas*, which supposedly were the least favourable of all as they showed no tendency to undergo what was thought to be cystic "degeneration."

We were in this primitive stage of glioma classification when in 1922 at my suggestion Dr. Martin made an end-result study of the tumors of the first category—the "gliomatous cysts." At that time the relation of the tumor nodule and its removal or otherwise to the survival period was scarcely suspected for though Case 2 cited was then living after

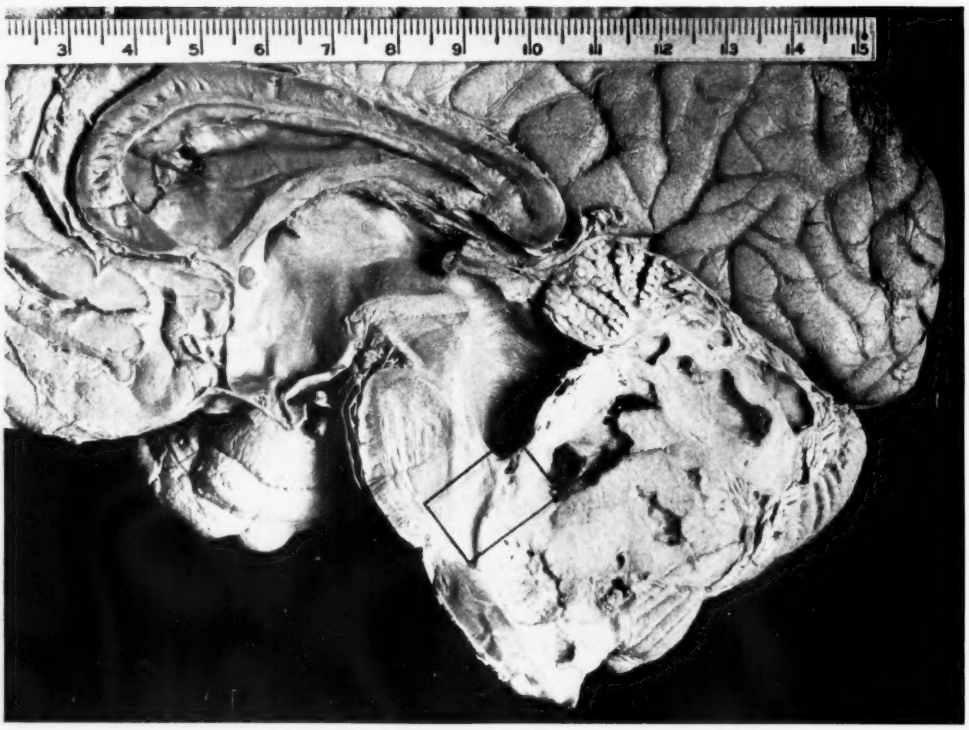


Fig. 6. (Case 6.) Mid-section of brain showing multicystic astrocytoma at terminal stage after ten years of symptoms unaffected by previous operations. Squared area represents site of block removed (1925) for special stains showing incorporation of tumor with brain stem without sharp demarcation. [Ref. p. 137.]

14 years, a tumor nodule having been removed with the cyst wall, Case 5 was also living after 11 years following a mere cyst evacuation.

All this was highly confusing and even though Dr. Martin's report (4) served to show that the average survival period of patients with "gliomatous cysts" was surprisingly long, a similar study two years later by Dr. van Dessel (5) of a group chiefly of non-cystic gliomas, which were undergoing sufficient calcification to betray their presence in X-ray films, had a correspondingly favourable prognosis. Highly dissatisfied therefore with our crude glioma classification and deprecating the fact that the "gliomatous cysts" based on xanthochromic fluid alone had come to be incorporated in our verified-tumor series [we then little suspected that some of them had an angiomatous rather than gliomatous basis], Dr. Bailey undertook the task to which I have already alluded of attempting histologically to classify the 400 or more gliomas in the collection into more or less distinct groups. Our programme was to follow two independent lines which were to converge, on the one hand the tedious microscopic re-examination by special stains of the tissues in the tumor collection, and on the other, the more mechanical but equally time-consuming task of overhauling and tabulating the clinical data and of pursuing patients and their family doctors for final results.

That such a schema of classification as was finally published three years later would serve merely as a useful working basis to be simplified and amended in the light of further experience was fully appreciated. In the course of this primary general survey it was found that

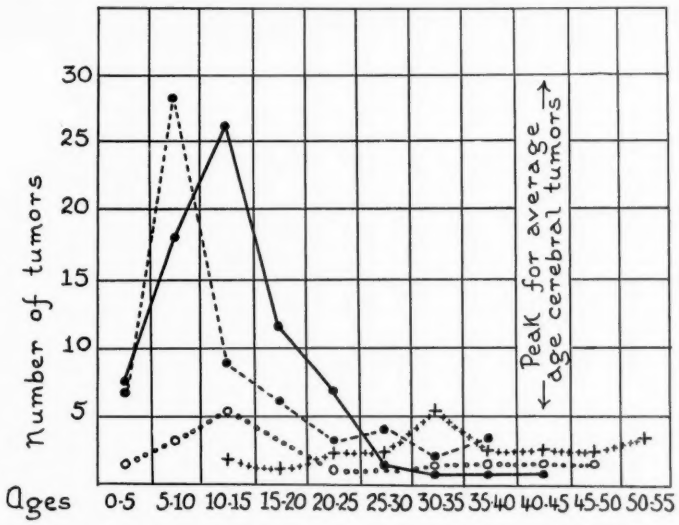


Fig. 7. Graph showing age incidence in hemi-decades of patients with four principal types of verified midcerebellar tumors: 76 astrocytomas (solid line); 62 medulloblastomas (broken line); 22 hæmangioblastomas (crossed line); 19 ependymomas (circled line). [Ref. p. 145.]

several cystic tumors with an angioblastic basis had come to be incorporated among the gliomas, and a subsequent detailed study of these particular lesions (3) disclosed the fact that they are almost invariably situated in the cerebellum. This naturally suggested that a detailed study of the several histologically-differing types of glioma might show that they too had definite seats of predilection. What is more, it is only in the course of such a particularized study of tumors of one type and position that their peculiar symptomatology begins clearly to stand out. Conversely; any inconsistency in behaviour and symptomatology of a histologically-classified tumor picked up in a systematic review of a group of cases immediately suggests that some error in the pathological diagnosis has inadvertently crept in and indicates that the case deserves thorough revision.

2. TABULATION OF CASES[1]

The tedious process of getting the main facts of a long series of cases in chronologically tabular order is essential to a study of the present sort. It not only serves to show when and how progress has been made but it brings to light the more notable deviations from what proves, on the basis of averages, to represent the common type.

A tabulation of the more definitely fibrillary astrocytomas which had been identified in the tumor series up to January 1, 1924, was published by Dr. Bailey and myself in our monograph on the gliomas (7). We, however, were at that time chiefly concerned with the histopathology of the lesions irrespective of their situation and had only begun to have glimmerings of the predilection of certain gliomas for certain sites. Of the 32 cases then identified, nine were cerebral, and the fact that these nine cerebral lesions occurred in patients with an average age on admission of 33 years whereas in the cerebellar cases the average age was only 13 years certainly required explanation.

Another peculiarity that needed looking into was the fact that among the remaining 23 patients with cerebellar lesions there were several in whom the symptomatic onset was at a surprisingly advanced age. A critical

[1]To be found appended.

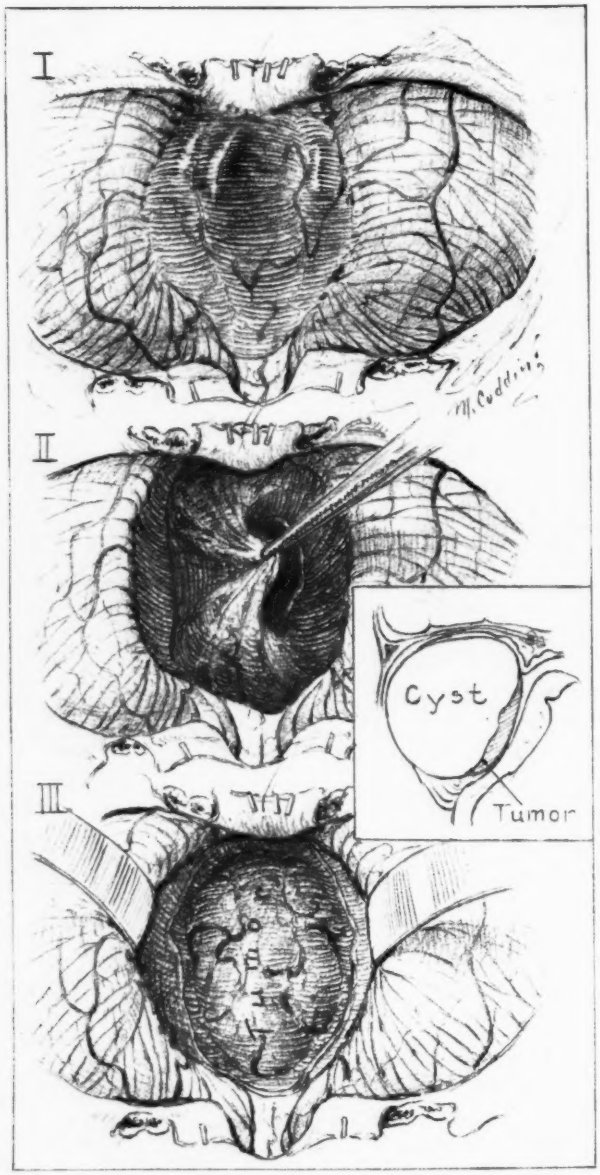


Fig. 8. (Case 61.) Essentially cystic, fully exposed median astrocytoma with flat mural nodule on the roof of the ventricle in an infant: I, primary view of lesion beneath arachnoid membrane; II, withdrawal of cyst wall; III, cavity showing residual mural tumor in depth. Insert, estimated mid-section of lesion. [Refs. pp. 151 and 160.]

re-examination of these exceptional cases discloses two unmistakable angioblastomas which had escaped us, a probable arachnoidal cyst with mural gliosis rather than tumor, and a tumor of which the diagnosis is highly questionable. A few other cases we have felt obliged to exclude because of the uncertainty of the location of the lesion, whether pontine or cerebellar, or because we were for other reasons in doubt. This leaves from our original 1908–1923 list of 32 only 19 examples of unquestioned cerebellar astrocytomas of fibrillary type.

Meanwhile, however, to this greatly reduced list of cases antecedent to January 1, 1924, nineteen additional ones can be added, making 38 in all, many of them being examples of "gliomatous cysts" which have since been histologically verified through secondary operations. What is more, for reasons to be more fully explained in the section on cytology, the cerebellar astrocytomas previously classified as protoplasmic have been incorporated in the Table because from a prognostic and practical point of view the attempt to distinguish between protoplasmic and fibrillary types among these cerebellar astrocytomas of childhood is needlessly artificial. It is most rare to find a fibrillary astrocytoma of the cerebellum without some area in which the cells are of protoplasmic type, rare also to find a tumor that is so predominantly protoplasmic as greatly to prolong a search for fibrils.

We consequently have come to feel that the tumors normally have a combined cytology, and their clinical behaviour and prognosis prove to be the same whether the cells of one or of the other type predominate. Accordingly, all astrocytomas of the cerebellum have

properly come to be allocated together. Thus as our knowledge of the behaviour and favoured situation of these different types of glioma increases and becomes more exact, the cases gradually tumble into their proper and possibly final categories.

In this fashion, a tabular survey by pointing out similarities as well as by pointing out the more striking type-deviations, serves to indicate where the attention of those studying the subject should be focused. In addition to this, the existing table as it stands is informing and useful in showing how the therapeutic procedures have, step by step, been modified to meet newly acquired information—when ventricular punctures began to be employed in course of operation, when cerebellar cysts were merely evacuated, when attempts were made to destroy the cyst walls by excision or fixation, when the importance of the mural nodule began to be appreciated, when tumor classification began to show its effects, when radiation was given a therapeutic trial, when the central position of the lesion began to be taken into account with vermis transection as the preferential method of its exposure, when electro-surgery first began to be employed. All these are matters which will be touched upon in their proper sequence.

3. GENESIS

In the recent critical review of the medulloblastomas (2) stress was laid on the fact that the majority of these tumors were median in position, occurred in early childhood and appeared to take their origin from the roof of the fourth ventricle, a vertical incision of the vermis being the favoured method of exposing them. This applied to 52 of the 61 cerebellar cases (85 per cent), there having been seven examples (15 per cent) which were exceptional in that the patients were older and the tumor was laterally placed in one of the hemispheres. The probable congenital origin of these tumors was assumed on the basis of their peculiar cytology, situation, occurrence in early life, and recorded presence in twins.

Among other tumors that show a predilection for this structurally complicated region constituting the roof plate of the fourth ventricle, the angioblastomas are unmistakably ascribable to a congenital fault of development and indeed, as Lindau's studies (8) have shown, possess definite hereditary tendencies. The same, I think, holds true of the ependymomas of this region.[1] Whether the tumors under consideration can with comparable probability be ascribed to some developmental fault in the region is less clear. The angioblastomas of the brain are, without exception it is safe to say, found only in the cerebellum; the medulloblastomas in our series, with two possible exceptions, are likewise confined to the cerebellum; the ependymomas, though more commonly cerebellar, begin to show a tendency to occur elsewhere, there having been eighteen associated with the fourth ventricle and seven with the cerebral ventricles; and finally the more numerous astrocytomas appear to be about equally divided between median cerebellar and scattered cerebral lesions.

Fig. 9. (Case 61.) Infant 22 months of age 17 days after operation to show hydrocephalic head, well healed wound and absence of protrusion. [Ref. p. 151.]

[1] These distinctive lesions were among the first of the gliomas to be easily differentiated. Reports from this clinic of six examples, four of them of the fourth ventricle, have been made by P. Bailey (9).

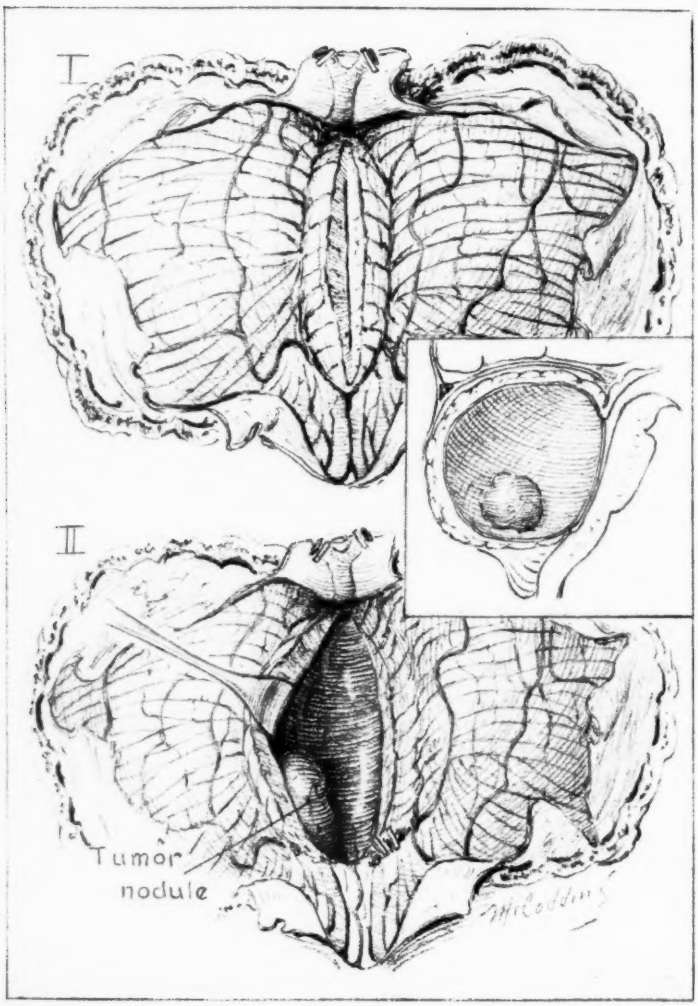


Fig. 10. (Case 57.) Showing: I, prominent vermis with primary incision; II, centrally disposed cyst with small, laterally placed mural nodule. [Ref. p. 156.]

4. INCIDENCE

1. Percentage. To September 10, 1930, the brain tumor series contained 805 gliomas of all kinds. For a variety of reasons the precise type of 204 of these tumors remains in doubt but the remaining 601 with a reasonable degree of accuracy have been definitely classified. Among them are 227 astrocytomas of which the 76 cases the subject of this report arise in the mid-cerebellar region. These represent therefore approximately 9.4 per cent of all the gliomas and about one-third of the astrocytomas of all types and all situations.

As already intimated and for reasons to be gone into later on, our interpretation of these cerebellar astrocytomas is changing in that we no longer feel disposed to distinguish be-

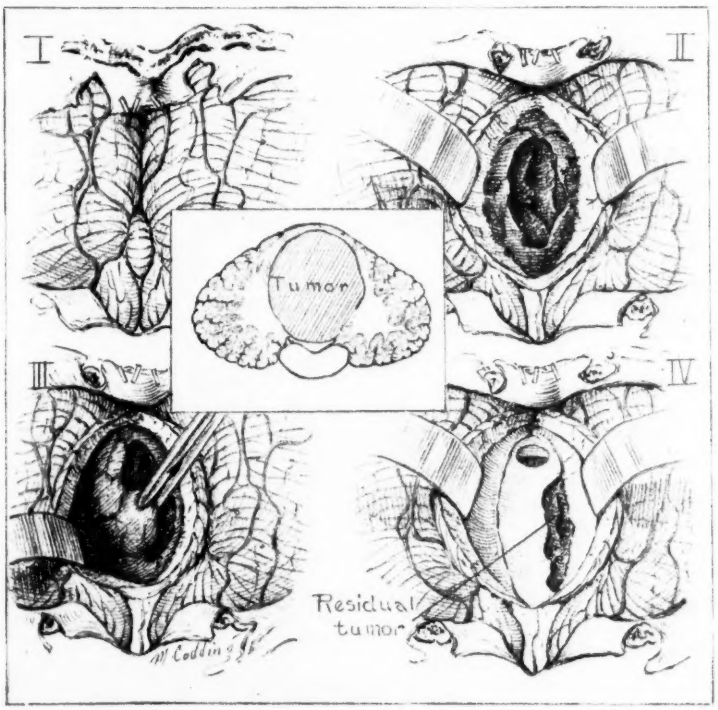


Fig. 11. (Case 69.) Sketches showing: I, the slightly prominent uvula and moderate tonsillar herniation; II, the deeply seated tumor partly exposed; III, the tumor being dislodged after primary excavation; IV, the residual edge of adherent growth and widely opened ventricle. Insert shows presumed site of the lesion. [Ref. p. 158.]

tween fibrillary and protoplasmic types, so far at least as the cerebellar lesions go. Whether further study will show, as we suspect it may, that the fairly numerous so-called protoplasmic astrocytomas of the cerebrum,[1] in view of their invasive tendencies and proneness to rapid recurrence, are tumors of less highly differentiated cells than astrocytes, remains to be seen. Whereas the benign astrocytomas of the type with which we are dealing and which tend to form cysts in their early stage of development seemingly occur in the cerebellum and cerebrum in approximately equal number, the invasive types of "protoplasmic astrocytoma" are not found in the cerebellum at all. They are confined to the cerebral hemispheres, occur almost without exception in adults, and have a prognosis almost as grave as that of the glioblastomas.

2. *Age.* A casual survey of the column in the table giving the patient's age on admission will show that the great majority were still pre-adolescent, the average age being 13 years. The average recorded duration of symptoms would lower the age of symptomatic onset to 11 years, which approximates the age on admission of the patients with medulloblastomas. Even this fails in all probability to give the correct impression, for the astrocytomas are most insidious in symptomatic onset, loss of vision from secondary optic atrophy being not infrequently the first recorded symptom. The accidental disclosure of the lesion in Cases 2 and 61, both of them

[1] The cerebral astrocytomas, 151 in number, are at present subdivided into 64 of fibrillary type and 87 of protoplasmic type. Many of the latter are rapidly growing infiltrative tumors with abundant mitoses and should in all probability be separately classified. They moreover occur in patients with the average age of 40 years whereas the 17 cerebellar astrocytomas formerly classified as protoplasmic had an average age of 13 years.

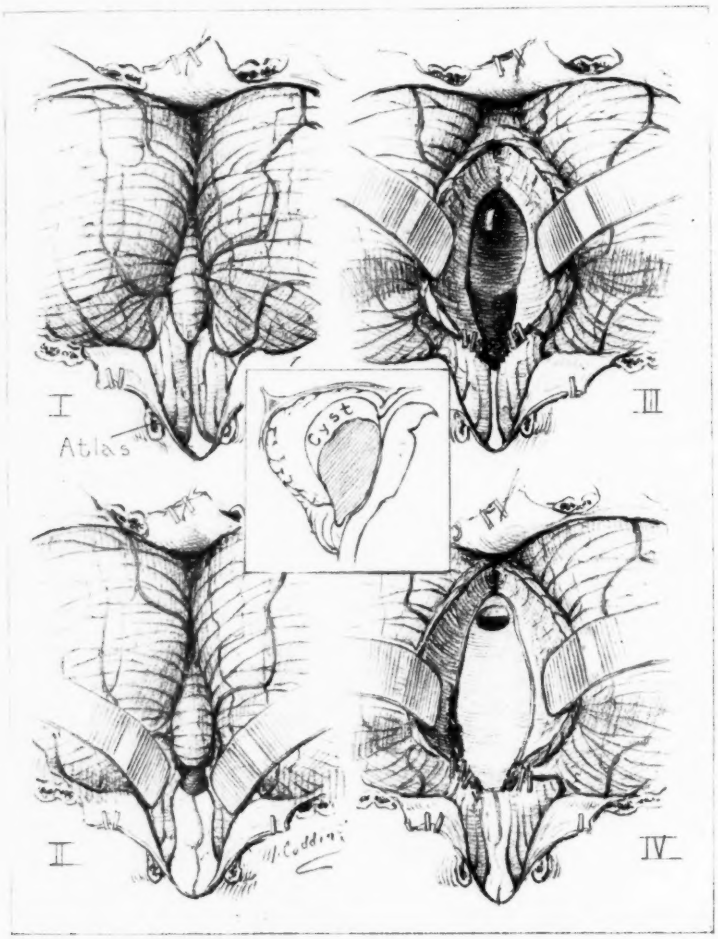


Fig. 12. (Case 64.) Showing: I, a slightly more prominent uvula than in Figure 11, with more marked tonsillar herniation necessitating laminectomy of atlas; II, the small nubbin of tumor exposed at the calamus; III, the deep-seated lesion with small overlying cyst after vermis transection; IV, the final wide exposure of dilated ventricle and aqueduct. [Ref. p. 158.]

children only 22 months old, was doubtless due to the unusual size attained by the cyst. Otherwise the symptoms might have been delayed for years.

These age calculations necessarily are made from what the clinical histories record and doubtless a more searching anamnesis when the older histories were elicited would have brought out antecedent symptoms that were then looked upon as irrelevant, such, for example, as matutinal vomiting ascribed to some gastric derangement of childhood and long forgotten. However this may be, not a few of the clinical histories of patients whose age on admission exceeded the average, clearly indicate a long-drawn-out preliminary story. Of this Case 5 provides a striking example, the patient, aged 17, having had

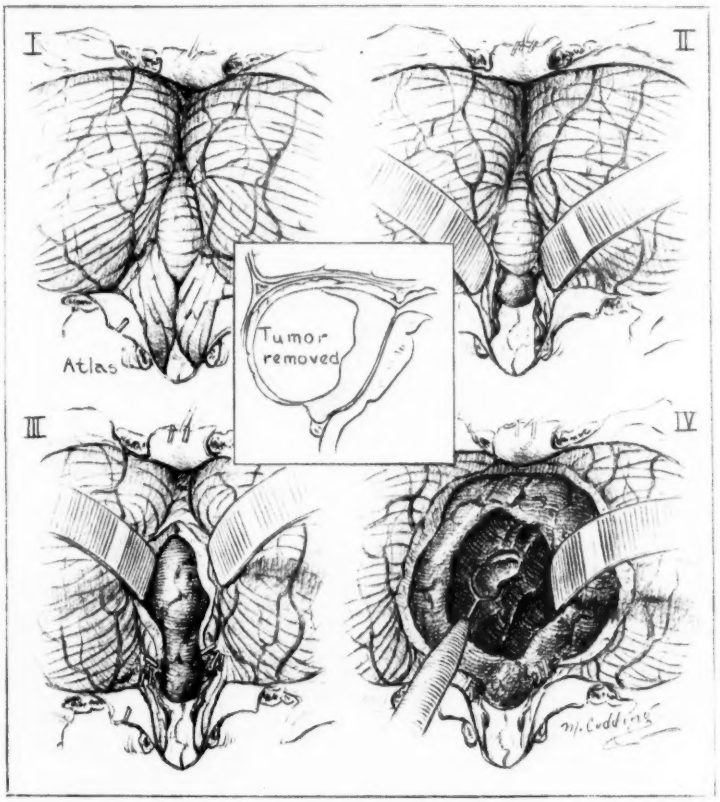


Fig. 13. (Case 70.) Showing: I, the slightly prominent vermis and tonsillar herniation necessitating laminectomy of atlas; II, the visible tumor shown by separating tonsils; III, median incision of vermis with clips on chief entering vessels; IV, the process of excavating tumor by scalloping. Insert shows estimated degree of extirpation giving temporary relief of symptoms. [Ref. p. 159.]

periodic attacks of suboccipital headache and vomiting for a period of thirteen years. Among other examples is that of a 21-year-old woman (Case 33) who had suffered from headaches and vomiting pretty much all her life and on whom a subtemporal decompression for unlocalizable tumor had been made five years before admission. Still another is that of a 16-year-old girl (Case 60) who for several years before she became conscious herself of any disability had been "teased" by her playmates because of her unsteady gait.

In the accompanying chart (Fig. 7) the ages of the 76 cases on admission are recorded in hemidecades together with the 62 verified medulloblastomas. The 22 angioblastomas and the 18 cerebellar ependymomas. The fact that the curves of the two larger groups do not more nearly correspond merely goes to show that the symptomatic effects of the astrocytomas become a source of anxiety less early in life. To put it in another way, the position of the peak of the curve may be taken as a measure of the awareness of practitioners, more particularly of pediatricians, ophthalmologists, and neurologists, in regard to the early symptomatology of these tumors. We may expect the peak slowly but certainly to move to the left in years to come.

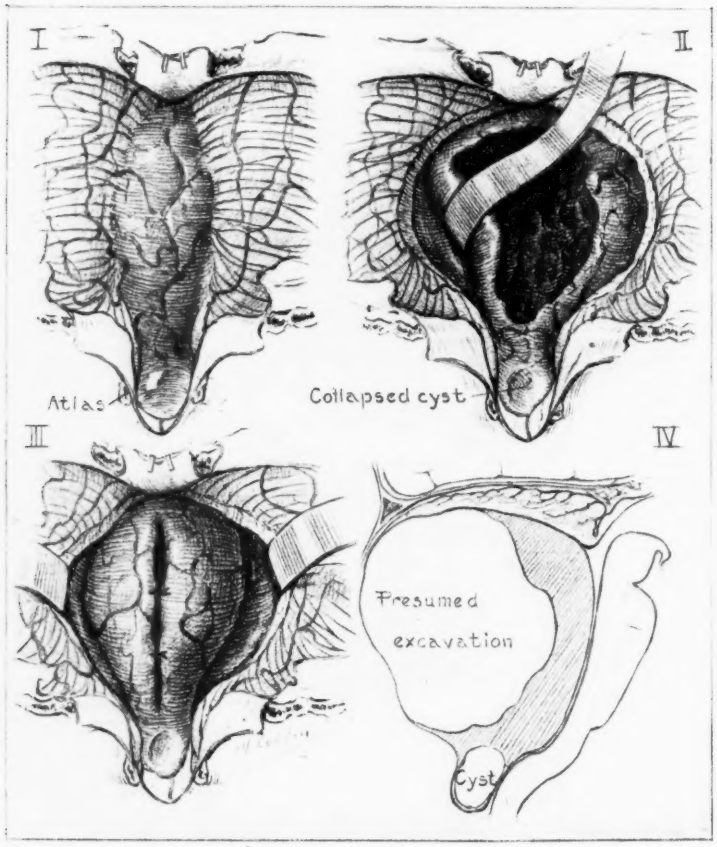


Fig. 14. (Case 68.) Showing: I, a solid median exposed tumor with cystic projection through foramen magnum; II, excavation in process with tilting inward of shell; III, suturing of tumor shell to diminish size of growth; IV, estimated mesial section (cf. Fig. 15.) [Refs. pp. 155 and 159.]

3. Sex. Whereas the medulloblastomas proved to be three times more common in males than females, the astrocytomas are almost equally divided between the sexes and there is no apparent reason why tumors of childhood should show any selectivity on this score.

4. Trauma. The time-worn question as to the possible relation of injury to tumors of any kind continues to repeat itself. Whether or not these tumors of childhood can be properly ascribed to some underlying fault of development, we cannot escape from the fact that a history of presymptomatic trauma is recorded in a surprisingly large proportion of the cases, particularly should one include under this heading the bruising effects on intracranial structures of paroxysms of coughing.

In consideration of the fact that pertussis is a common episode of childhood and that children are prone to fall and bump their heads, it may be assumed that these accidents to which the malady is so often ascribed by parents have merely served either to activate a latent growth or to call attention to symptoms previously unobserved. "Unsteadiness first observed during convalescence from

Fig. 15. (Case 68.) Brain on midsection showing larger residual tumor than expected (cf. Fig. 14, iv). Note small superficial cyst projecting through incisura, the degree of hydrocephalus, and the forward displacement of the entire brain stem. Patient had essentially no symptoms till two months before admission. [Refs. pp. 154 and 160.]

whooping cough"; "suboccipital headache and vomiting after a fall from a swing"; "a fall on the ice when skating with prompt occurrence of noticeable instability"—remarks such as these punctuate the anamneses of the records.

5. SYMPTOMATOLOGY

In describing the cerebellar medulloblastomas (2), it was pointed out that the chronology of symptoms does not vary greatly from case to case and this is no less true of the astrocytomas. Indeed, the chief and one may say only clinical difference between the two lies in the relentless progress of the former and the more slow and often interrupted symptomatic advance in the case of the astrocytomas, which has its tragic side in that impairment of sight is often the first thing to call attention to the fact that something is seriously wrong with the child. Could one make a composite of the histories of all the cases thereby eliminating their more exceptional features, a story somewhat as follows would emerge:

A child apparently normal in all respects begins toward the end of the first decade, possibly after a fall or an attack of whooping cough, to have early morning headaches with vomiting. Nothing much is made of this by the family doctor, should he be called in, for the child subsequently feels perfectly well, has had breakfast and wants to go out and play. This daily performance may continue for a considerable time, the child even going to school meanwhile. There may then be a remission of weeks

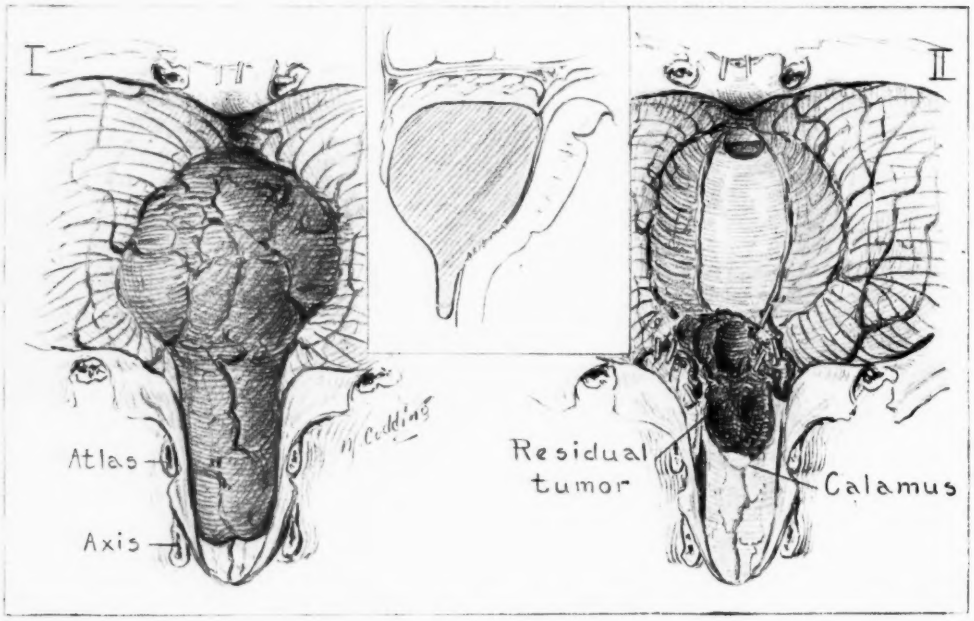


Fig. 16. (Case 53.) Showing: I, median astrocytoma which has come to the surface with a spinal tongue necessitating laminectomy of both atlas and axis for its exposure; II, the residual part of the tumor after incomplete extirpation. [Refs. pp. 160 and 180.]

or perhaps months and the episode be forgotten. On their re-occurrence, the symptoms are likely to be more pronounced and are apt to be ascribed to some gastro-intestinal disturbance. This appears the more probable since the child finds that straining at stool brings on a headache and there is a tendency to become constipated. What is more, a mild daily laxative usually serves completely to mask the symptoms.

This sort of thing continues off and on until it becomes evident that the child is a little clumsy at play and gets knocked over easily. Very possibly, ere this, the periodic headache and vomiting will have ceased completely or at least have occurred at much longer intervals; and if parents are observant they may notice that the child's head in the interim has increased in size more rapidly than it should. This, however, is usually discounted for the child meanwhile has become free from complaints and in all respects appears alert and well.

Matters may run on in this way for an indefinite time, possibly with some increase in clumsiness of movement or in some instances with no noticeable change whatever until it suddenly becomes apparent, perhaps at school, that the child's sight is poor. To counteract this glasses are usually prescribed; but even should an ophthalmoscope be resorted to, a child's retina is less easily examined than that of an adult and, because of the decompressive effects of the enlarging head, the optic papillæ often show no measurable swelling and the fact of their being pale and with margins blurred may easily pass unrecognized.

Due to the insidious nature of the symptomatic onset, it is in this pre-amaurotic stage of the process that even today the victims of these mid-cerebellar astrocytomas, as the Table will show, unfortunately continue to be admitted to hospital.

The headaches of which the patients complain are often frontal rather than suboccipital in location and in a few instances the frontal sinus had been explored under the belief that there must be a concealed infection. Indeed, by the time the headaches come to be localized in the suboccipital region the patient no longer refers to them as such but rather as local discomfort or a painful stiffness in the neck which is aggravated by any sort of effort likely to produce intracranial venous congestion.

Unquestionably the symptoms of these cases, even the headaches and vomiting, hinge more upon the variability of tension of

the secondary hydrocephalus than upon the purely local factors. That some slight degree of hydrocephalus must be an early sequel even of a small tumor that overlies the fourth ventricle is easily understood. No less well known is the fact that in children the skull quickly and readily expands by separation of the sutures, *pari passu* with the formation of an obstructive hydrocephalus. But that a large, mesially placed and slowly growing tumor of the fourth ventricle may elicit no localizing symptoms whatsoever, should the pressure effects of the hydrocephalus be eliminated, is less well appreciated. And since this has considerable bearing upon the periods of relative symptomatic freedom which the histories of these patients bring out, it is worthy of the special emphasis which the following illustrative history will carry:

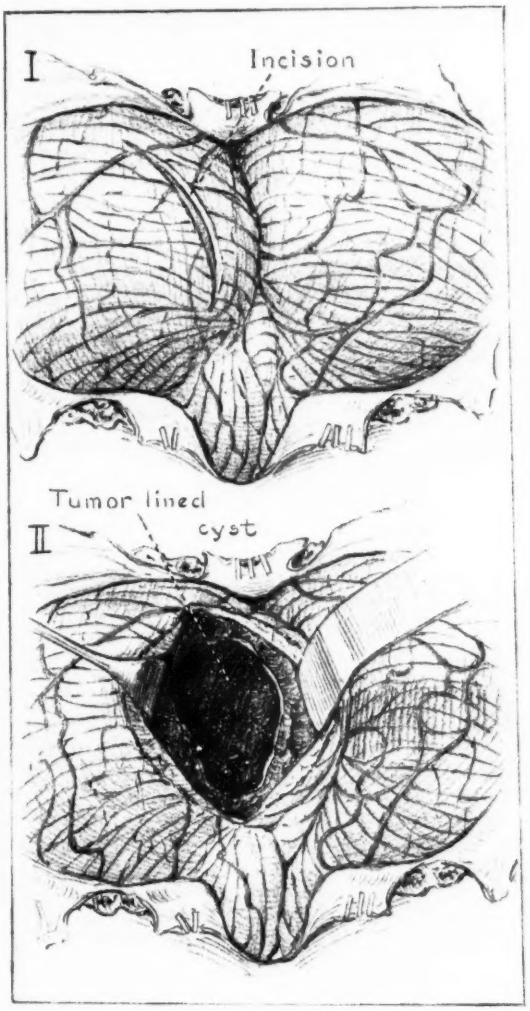


Fig. 17. (Case 44.) Showing: I, the asymmetrical posterior surface of the cerebellum with almost wholly concealed vermis; II, primary incision through bulging hemisphere entering a large tumor-lined cyst. [Ref. p. 161.]

CASE 52. This boy, who was twelve years old when admitted on September 27, 1927, had a history of having been dropped when one year of age, severely bumping his head. Headaches described as bitemporal were subsequently of periodical occurrence and in time they came to be replaced by occipital discomforts not termed headaches which have continued to the present time. Six months before admission there had been attacks of projectile vomiting with complaint of stiffness of the neck. Instability of gait had been observed for two or three months. There had been some subjective haziness of sight for one week, and two days before entrance there had been a typical cerebellar convulsion. The child had been in more or less regular attendance at school, until six weeks previously.

The examination showed choked discs of 3 D. with normal visual acuity in spite of some new tissue formation. Though nystagmus was absent there was unmistakable ataxia with dysmetria and hypotonia in all extremities, more pronouncedly on the right side. There was a positive bilateral Babinski with ankle clonus.

The diagnosis of a median cerebellar tumor was made, and the case was scheduled for early operation. In view of the threat to vision he meanwhile was given magnesium sulphate in amounts sufficient to provoke free catharsis. Under this treatment, as so often happens, his symptoms such as they were faded away, which accounts for the following statement which precedes my dictated description of the operation: "I do not recall when I have undertaken a cerebellar operation with less assurance of disclosing a lesion than in this boy's case. When examined yesterday afternoon, I positively could find no symptoms worth recording apart from his choked discs and the unmistakable hydrocephalic pressure changes in the skull. He certainly had no demonstrable cerebellar symptoms that would ordinarily have been accepted as such. The localizing diagnosis lay solely on the anamnesis and on the neurological tests on admission. In view of this it was the more astonishing that so large a median tumor was found."

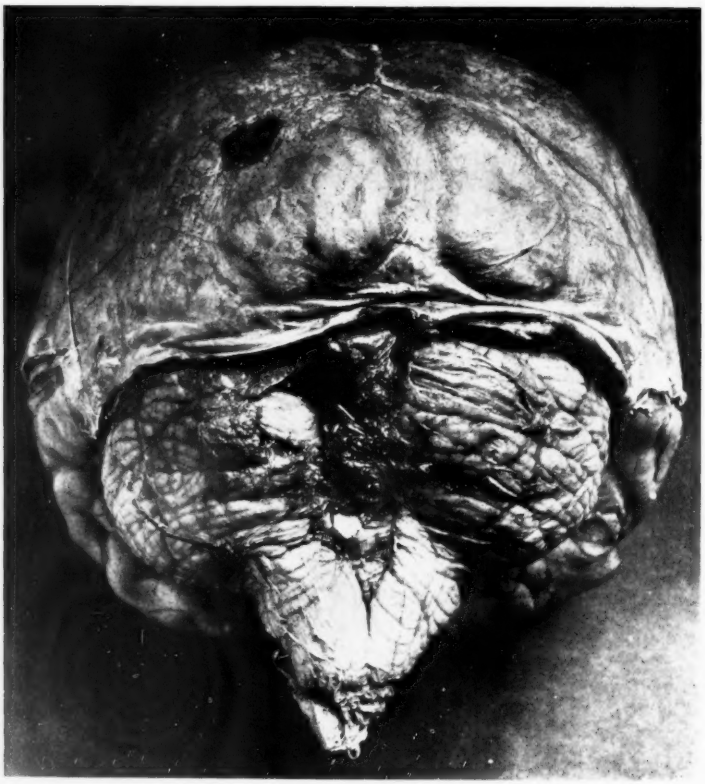


Fig. 18. (Case 44.) Posterior aspect of the cerebellum (⅔ nat. size), to show the extent of pressure cone. Death due to postoperative formation of a clot in the partly excavated cavity of the tumor. [Ref. p. 161.]

A capacious median cyst was disclosed within which was an astrocytoma estimated to be the size of a hen's egg that directly overlay the roof of the distended fourth ventricle which was wholly exposed after extirpation of the growth.

Naturally enough the earlier in life the symptoms put in an appearance, the more rapid and evident will be the enlargement of the head. In the two youngest patients in the series not yet two years of age, there was little to show but hydrocephalus and a low grade of choked disc such as might accompany a mid-cerebellar lesion of any type—or indeed characterize an acquired hydrocephalus from some cause other than tumor. Both of these infants proved to have exceptionally large cysts with a flat mural tumor. In the first of them already described (Case 1), the cranial expansion was the sole premonitory symptom which had come on after an apparently normal early development.

The history of the second, a more recent case, in which the only premonitory symptom was instability, is as follows:

Case 61. The child, 22 months of age, was admitted on December 31, 1928, with the sole complaint of having lost the ability to walk. A full-term baby born February, 1927; breast fed; normal dentition; crawled at 7 months; took steps at 9; very active on feet at 12—a normal infant, so far, with perfect health. When 16 months old in June, 1928, there was a single attack of morning vomiting which was never repeated. A month later he began to walk unsteadily and this gradually increased. By September he would often fall and latterly he had

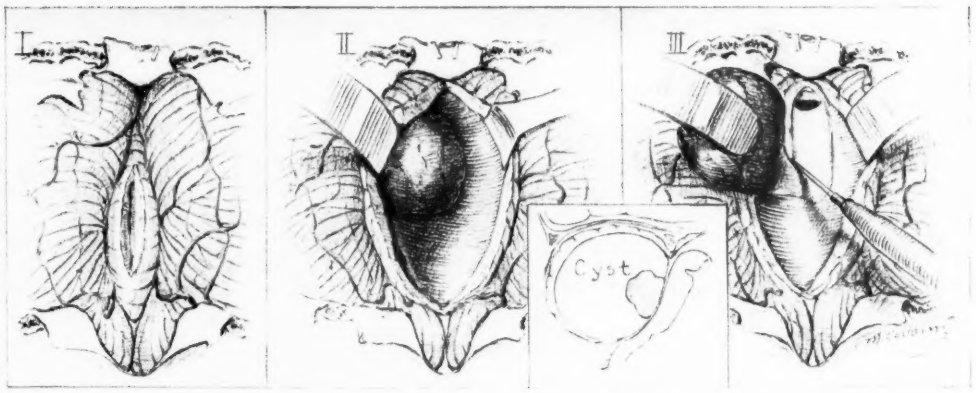


Fig. 19. (Case 55.) Showing: I, moderately prominent vermis vertically incised to wall of cyst; II, exposure of mural nodule; III, method of extirpation with partial excision of roof of ventricle. [Ref. p. 161.]

required support when walking. Otherwise there were no complaints and no observed symptoms. There had never been any headache.

Examination showed a normal appearing, alert, smiling, and responsive child, contentedly occupied with his pictures and toys. The head was unduly large, but the parents insisted that it was no larger than was his elder sister's at the same age. The cranial roentgenograms nevertheless showed a thin vault, a slightly expanded sella, and separation of the coronal sutures indicating hydrocephalus. The eyegrounds were difficult to examine but they showed what was taken to be an early papillœdema. There was typical inco-ordination of cerebellar type with some hypotonicity involving the lower extremities and a wide-stepping, unstable gait. The upper extremities were apparently wholly free from ataxia. There was no nystagmus. The temperature (rectal) was irregular ranging from 97° to 101°. The clinical diagnosis of a median cerebellar tumor was made, a medulloblastoma or tuberculoma being favoured.

At operation on January 8, 1929, the dura with shreds of arachnoid was found to be somewhat adherent to a bulging, central, dark, thin-walled cyst of amazing dimensions occupying fully a third of the exposed field (Fig. 8). The cyst was found to contain canary-coloured fluid, the amount estimated at 80 cubic centimeters. Its wall was tough enough to be grasped and brushed away from the lateral hemispheres but in the depth of the cavity, about as shown in the sub-sketch, a flat layer of mural glioma was seen to overlie the ventricle. Though a start was made toward the removal of this mass, the systolic blood-pressure had fallen off to 60 so that after taking sufficient tissue for histological purposes without actually getting into the ventricle, the operation was concluded. The tissue on microscopical examination was found to be a typical fibrillary astrocytoma.

Convalescence was uninterrupted, and when discharged on January 28 the child (Fig. 9) was already walking with much less instability. He soon became symptom free and when last examined in June, 1930, still remained so.

Experience indicates that a secondary operation will be called for at some future date in this youngster's case, but meanwhile he to all appearances is a normal, active child. What we must look forward to in all certainty, in consequence of having abandoned the operation short of removing the mural tumor, is illustrated by the history which follows. The case, however, was not primarily chosen for this purpose but for the reason, more appropriate to this section, that disturbances of sight represented the inaugural symptom.

Case 28. A healthy appearing boy, 16 years of age, was referred to the clinic November 3, 1921, because of "eye trouble." A year previously he had fallen from a horizontal bar in a gymnasium striking his head on the mat. He was said to have been unconscious for eight minutes. At about this time he began having "blind spells." They usually occurred during the latter part of the day and were described as a sudden blurring during which everything turned a homogeneous gray color for about fifteen seconds when sight would slowly clear. There meanwhile had been a perceptible loss of visual acuity and for three months a tendency to diplopia. He had seen three different "eye specialists" who prescribed glasses, exercises for the strabismus, etc. There had been no headaches, vomiting or discomforts of any kind and only on close questioning was a tendency to being unsteady on his feet admitted by the boy who ascribed it to his seeing double. He

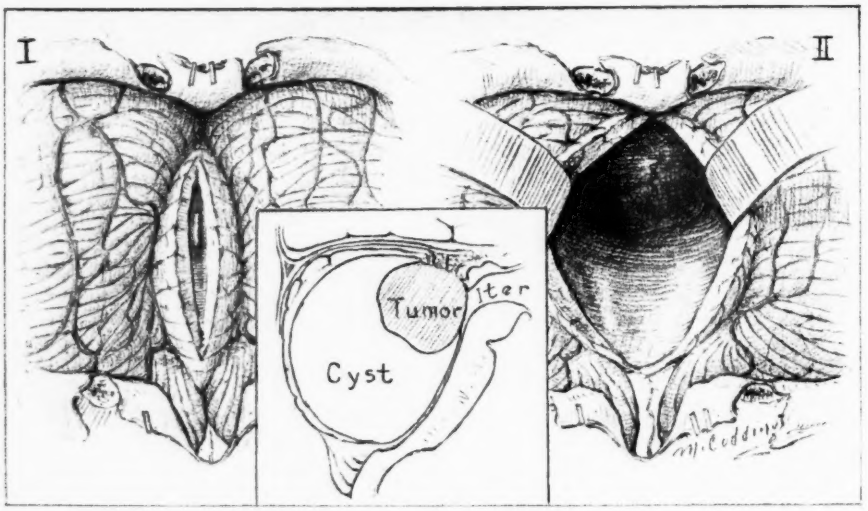


Fig. 20. (Case 54.) Showing a case similar to that in Figure 19 with tumor nodule attached to the upper thin wall where vascularity is likely to give trouble. [Ref. p. 161.]

nevertheless had continued in attendance in high school till shortly before admission which had been precipitated by his failing vision.

Examination showed a healthy appearing lad with a choked disc of five diopters in the stage of beginning atrophy, a slight left internal strabismus, and definite nystagmus. Tests for cerebellar function were all negative except for slight possible unsteadiness in standing tandem with closed eyes. Cranial roentgenograms showed convolutional atrophy and questionable thinning of the bone in the suboccipital region where there was tenderness on pressure.

At operation, apart from demonstrable hydrocephalus and a definite pressure cone, no abnormalities were disclosed and exploratory punctures of the hemispheres were negative. A rapid subsidence of the choked discs with preservation of 20/70 acuity followed this procedure which amounted merely to a decompression.

Nearly three years elapsed when on November 17, 1924, he re-entered the hospital because of the recent onset of suboccipital headache and projectile vomiting with fullness of the suboccipital region. During the interim, despite his impaired vision, he had been earning a modest livelihood as drummer in an orchestra of sorts. Apart from some slight unsteadiness, continued periodic diplopia and marked constipation, he had considered himself reasonably well. Examination at this time showed, in addition to his moderate secondary optic atrophy, definite cerebellar symptoms with nystagmus, a positive Romberg, and considerable inco-ordination.

At a second operation, a xanthochromic (40 cubic centimeters) cyst was detected in the left hemisphere and a horizontal incision was made down to it. On widely opening the cyst gliomatous tissue was seen on its mesial surface. In attempting to remove the growth it was found to extend down to an inaccessible depth in the midcerebellum, and after a prolonged session the extirpation was abandoned short of completion.

Following this operation there was a remarkable and prompt subsidence in all the cerebellar symptoms. He was given a series of X-ray treatments and discharged December 23, 1924, in excellent condition. During the next year while the X-ray treatments were being kept up, he was seen a number of times with his symptoms about stationary.

He was re-admitted to the hospital shortly before Christmas of 1925 because of increasing instability, an accentuation of his diplopia, and a sudden right facial paralysis. He was allowed to go home for the holidays and his re-entry for some unfortunate reason was delayed until February 12, 1926. On the night of his admission after a severe attack of vomiting, he became suddenly cyanotic, and died shortly after from respiratory failure with a rectal temperature of 109° F. There was no postmortem examination.

The chief reason for this recital is to emphasize that the symptomatic onset may relate to vision alone. The anamnesis, to be sure, cannot always be depended upon. The parents of this particular lad were neglectful (he was one of several children) and it is quite probable that symptoms dating from child

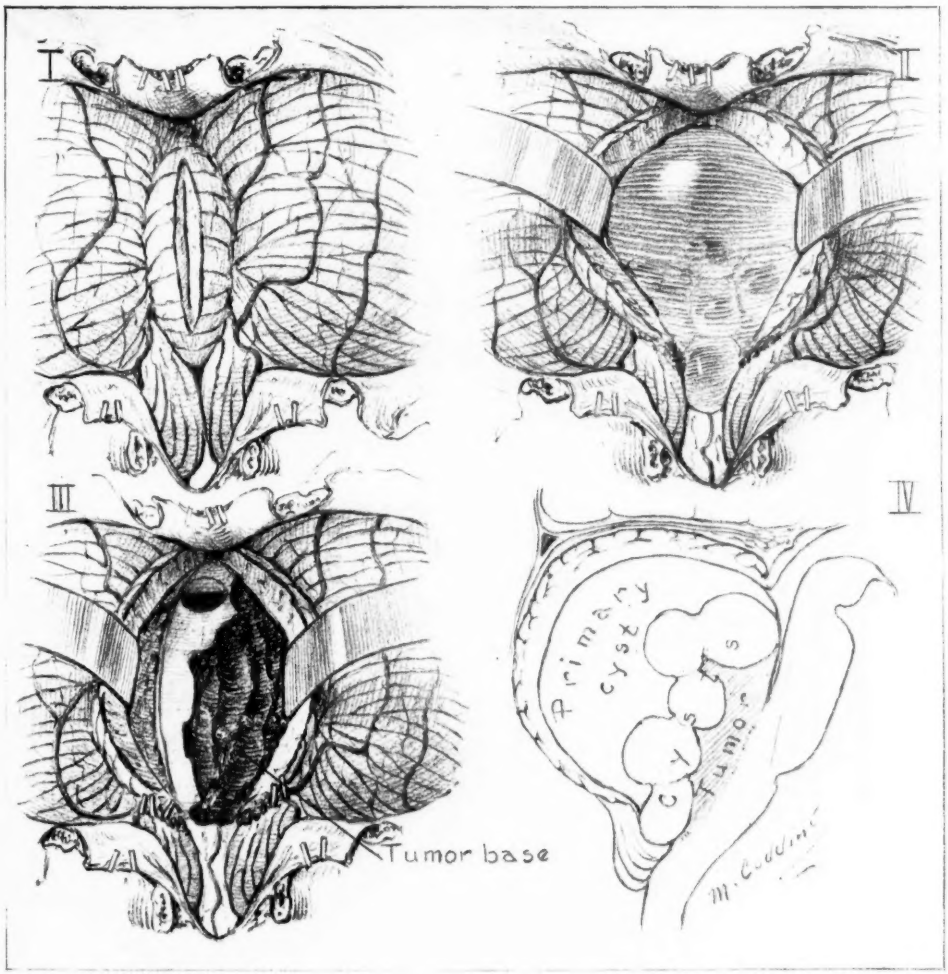


Fig. 21. (Case 59.) Showing: I, the bulging vermis incised; II, the median cyst fully exposed; III, the residual laterally adherent tumor incompletely removed; IV, diagram of the tumor on median section. [Ref. p. 161.]

hood may have gone unobserved or were forgotten.

There, however, are other interests in the case apart from the unusual chronology of symptoms. Among them are: (1) the fact that after the first and negative exploration the patient remained symptom free for so long a time that the contemporary surgical diagnosis of chronic arachnoiditis or pseudotumor was thought thereby to be sustained; (2) the fact that the cyst was opened at the second operation by a transverse cerebellar incision which rendered impossible a total extirpation of its deep lying and solid portion; and (3) the following facts regarding the pathological diagnosis, for in 1924 there was uncertainty as to whether the lesion was a fibrillary glioma or gliosis in the wall of a cyst. In 1925, Dr. Bailey recognized its astrocytomatous nature and classified it as

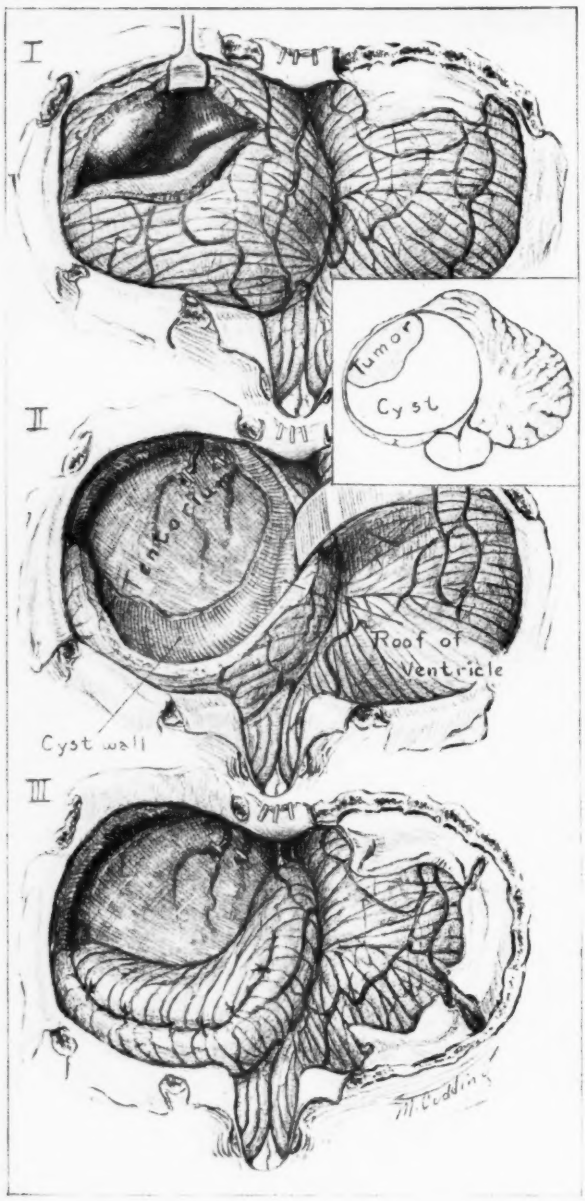


Fig. 22. (Case 66.) Showing: I, large lateral cyst with nodule underlying tentorium; II, cavity after extirpation; III, the replacement and suture of the collapsed hemisphere. Sub-sketch shows relation of cyst to roof of ventricle. [Ref. p. 161.]

protoplasmic, and we now look upon it as an astrocytoma which is sparsely fibrillary. But however classified the lesion was benign and might have been exposed and successfully removed at the first session had we known in 1921 what we were soon to learn.

How relatively mild the symptomatic picture may be even in the presence of a central lesion of magnitude is illustrated by the story of the child whose massive tumor, as revealed at autopsy, is shown in Figure 15:

Case 68. An eight-year-old school girl from a remote country district in Vermont was admitted on December 17, 1929. At the age of four she had unaccountable diurnal bouts of headaches and vomiting which continued over a period of six months. There followed a six months' period of complete freedom when the attacks began again and lasted for four months. She was then said to have remained, apart from an occasional complaint of stiff neck, perfectly well and active for the next three years. Two months before admission the well remembered headaches and vomiting returned with increased intensity and for the first time instability was observed.

Examination showed a little girl with the by-now-familiar symptomatology of a median cerebellar tumor: *viz.*, instability, ataxia and inco-ordination chiefly affecting the lower extremities with hypermetria and hypotonicity but with no nystagmus; a positive Romberg with tendency to fall backward; a bilateral choked disc with secondary optic atrophy but with essentially normal vision. The head was not apparently enlarged, there was no tenderness or Macewen's sign on percussion, the X-ray showed no evidence of hydrocephalus nor enlargement of the pituitary fossa. Reflexes were all within normal limits.

During her attacks of morning vomiting and headache she was inclined to assume an opisthotenoid position but there had been no cerebellar seizures. The fact shown by the Table that the operation was not carried out until ten days after admission indicates that the case was not regarded as urgent. There nevertheless proved to be a compact

median tumor of unusual size (cf. Figs. 14 and 15).

All things considered, it is fair to say that up to the point when one of these tumors attains such a size as markedly to flatten the medulla with the production of cerebellar seizures and their threat of respiratory failure, the local symptoms in the general run of cases may be surprisingly inconspicuous. To be sure, when there is a large cyst which comes to bulge, as it often does, into one hemisphere more than another, not infrequently carrying the mural tumor with it, the cerebellar syndrome may show unilaterality in favour of the right or left side and nystagmus may be expected.

Even though the astrocytomas tend (cyst included) to be lesions of greater magnitude than the average run of medulloblastomas, what chiefly distinguishes them from tumors of the latter type is not only their longer course but their intervals of comparative symptomatic freedom. This may conceivably be due to alterations from time to time in the degree of tension of the cyst, but as previously stated, it is with greater probability ascribable to the varying degree of tension of the hydrocephalic ventricles which at times press downward upon the tumor more severely than at others. It is this compression from above which leads to the more serious symptoms and in the terminal stages provokes the critical cerebellar seizures.

Anything which tends to increase this intraventricular tension, like compression of the veins of the neck, greatly aggravates the symptoms. So does coughing or sneezing or straining at stool, this having much to do with the constipation of which most of these patients complain; and I have known a child to die from respiratory failure following a cerebellar fit brought on by the effort to expel an enema.

It is the hydrocephalus, moreover, that is responsible for the most serious symp-

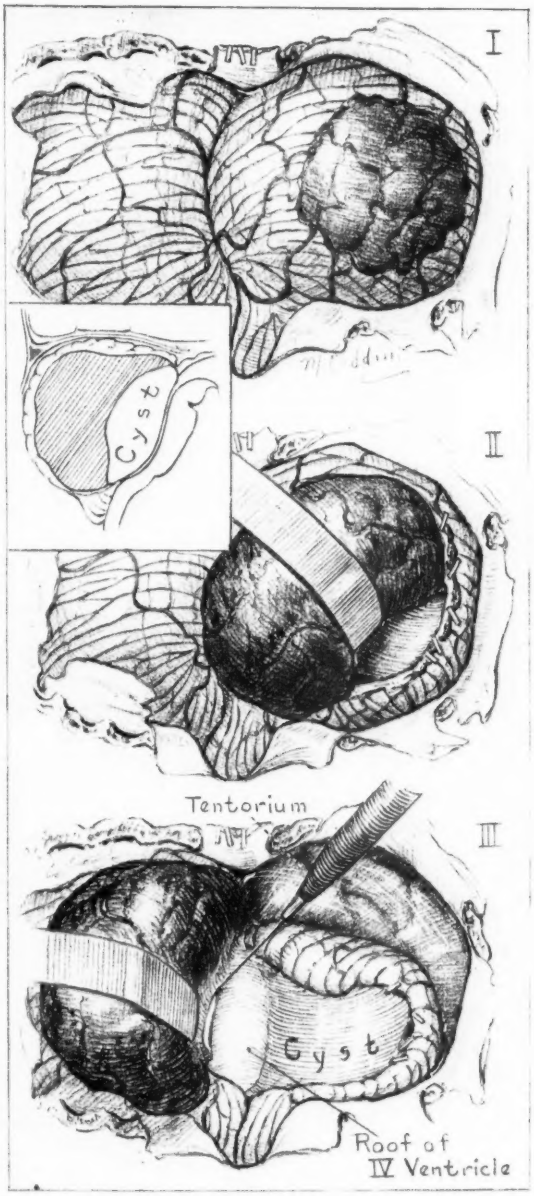


Fig. 23. (Case 30.) Showing (2/3 nat. size): I, large surface tumor exposed in right hemisphere; II, reflection of growth opening underlying cyst; III, bulging roof of ventricle in bottom of cystic cavity. [Ref. p. 161.]

toms of all from the standpoint of a useful life after a successful operation: namely, blindness. It was stated in connection with the 61 cerebellar medulloblastomas that impaired sight was noted at the time of admission in 26 cases, 9 of whom were already blind. This calamity, as might be expected from their more insidious advance, is still more commonly met with in patients with astrocytomas, 40 of the 76 patients having had impaired vision at the time of admission, 22 of them having already become blind or nearly so. As all but the two infants had at the time of admission an advanced degree of choked disc, it is safe to say that they would all shortly have become blind without operation. This is a serious reflection on our diagnostic shortcomings and merely goes to show that medical practitioners have not as yet become as awake to these tumors of childhood as they have to the prevalence of cerebral tumors in adults.

6. PHYSICAL EXAMINATION

The physical signs are essentially those characterizing the medulloblastomas. Indeed, when there is nothing in the history to suggest a symptomatic onset exceeding the usual six to twelve months, the two conditions when the patients first come under observation may be symptomatically indistinguishable. They are apt to be well nourished, placid, friendly, co-operative children who quickly become ward pets. They may possibly have learned to avoid ill temper and crying lest it increase headache and they usually submit to operations under local anæsthesia with surprising fortitude. Such ataxia as may be present chiefly affects the lower extremities; they walk cautiously with a broad base. The head is large and gives Macewen's "cracked pot" note on percussion. There is often suboccipital tenderness but in view of the usual median position of the growth tilting of the head is not noticeable.

The indications of cerebellar involvement are now too well known to need particular comment other than to recall the fact that they may be inconspicuous and that nystagmus is often wholly absent or represented merely by a few fine poorly sustained twitches. The hydrocephalic expansion of the head is often so out of proportion to the determinable cerebellar signs that recourse may have to be had to preliminary ventriculography. This may be necessary to eliminate a possible tumor of the third ventricle which is no less likely to cause a secondary hydrocephalus; and both conditions naturally lead to demonstrable expansion of the sella turcica. When this procedure reveals normal filling of an expanded third ventricle, it should be followed by operation without delay, as the ventricles customarily refill tighter than before in a few hours' time. Should this rule not be followed, serious consequences may sometimes ensue as exemplified by the following record:

CASE 57. A young woman 27 years of age, blind from secondary atrophy, was admitted May 11, 1928, with an obscure history of recurrent headaches and vomiting since early childhood. Her age was against a cerebellar tumor and the symptoms were sufficiently obscure to make desirable the added information from ventriculography, a marked hydrocephalus with no filling defect of the third ventricle being disclosed. Surgical intervention was postponed and that night she had a serious and her first cerebellar convulsion which forced us into an emergency operation the following morning. By good fortune a cystic lesion (Fig. 10) was found with a small laterally placed nodule easily accessible to electro-surgical removal without opening into the fourth ventricle.

The clinical picture presented by patients admitted with the syndrome highly advanced —when they have become blind, bedridden, and stuporous, have projectile vomiting, show oculomotor and possibly facial palsies, when recourse must be had to nasal feeding owing to the difficulty of swallowing, and when a cerebellar seizure may be provoked by some sudden passive movement of the patient's head—all this, which portends a sudden exitus and makes surgical intervention exceedingly hazardous, need hardly be gone into in detail.

7. MORBID ANATOMY OF THE LESION

The adaptability of the body to slowly developing pathological processes is well known, but that tumors of such magnitude in such a critical situation and so certain to produce early hydrocephalus can be tolerated for so many years with so comparatively insignificant symptoms is a continued source of astonishment. What is no less remarkable is the

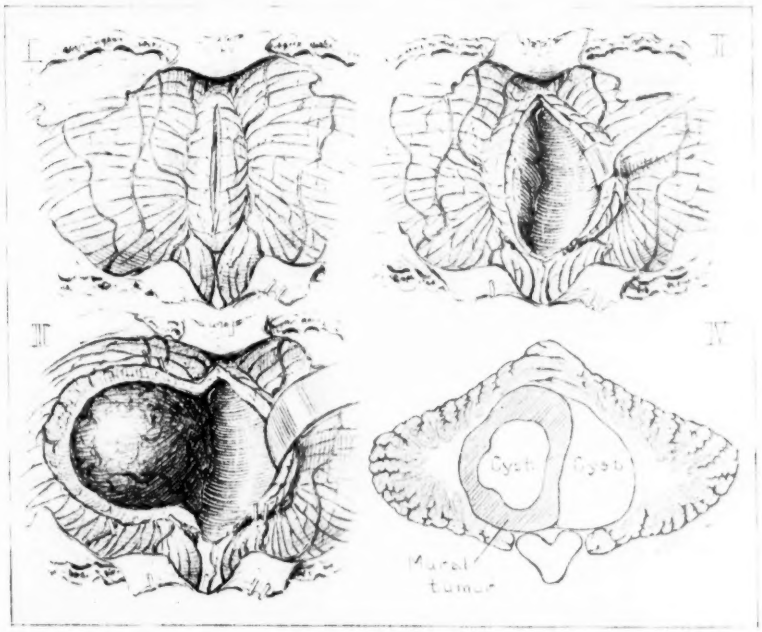


Fig. 24. (Case 62.) Showing: I, the exposed field with incised vermis; II, the open cyst and laterally placed tumor; III, the left hemisphere "uncapped" to give proper access to growth for its enucleation; IV, diagram of imaginary cross section. [Ref. p. 162.]

fact, betrayed by the tabular list, that in six of the early cases the tumor was not found at the primary exploration. To this oversight a number of factors doubtless contributed, the more important being the surgeon's failure understandingly to scrutinize the median structures of the exposed posterior cerebellar surface for any deviations from the normal topography. Another element lay in the fact that the essentially mesial position of the lesion was long unappreciated, little or no attention having been paid to abnormal prominence of the vermis, which, indeed, owing to the routine procedure introduced in 1910 of lowering tension by tapping the cerebral ventricle before opening the dura, might for the moment have lost what degree of prominence pre-existed. Still another factor in causing these deep lesions to be overlooked or misjudged was the universal custom, when no surface lesion was apparent, of puncturing the lateral cerebellar hemispheres in the hope of striking and evacuating a cyst, their frequent occurrence in the cerebellum having become well known. Indeed, a palpable cyst, pointing in one or the other hemisphere, might have been laterally opened with no conception of its source of origin and of what lay behind it.

The appearance at operation. With the alterations in surface topography, so important to the surgeon, the pathologist does not concern himself; nor would the minor distortions be sufficiently well preserved in a cerebellum containing one of these tumors even had the brain been hardened *in situ* before removal. Moreover, the surgeon must bear in mind that a cerebellum with no external evidence of distortion or tension may yet contain a deep median tumor only to be disclosed by median transsection of the vermis; and the courage to take this radical step will depend on the degree of dependence one places in his pre-operative diagnosis.

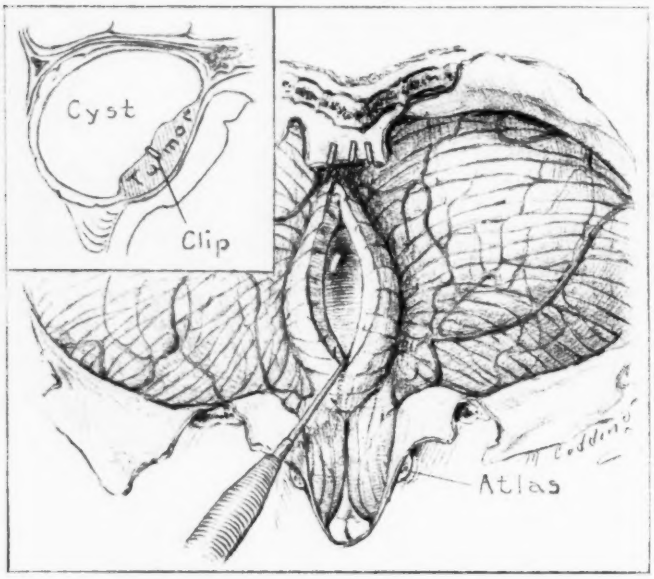


Fig. 25. (Case 43.) Condition found at original operation in 1925, the mural tumor having been left undisturbed owing to its vascularity. [Ref. p. 162.]

From what is essentially a normal appearing posterior cerebellar surface with a wholly concealed tumor one meets with all manner of variations up to huge centrally placed, fully exposed lesions either solid or predominantly cystic. Selections from the sketches of the fields of operation will serve better than descriptions to show some of these variations. The drawings at the same time illustrate certain stages in the surgical procedure, which will be touched upon here with brevity and only in so far as they are of primary pathological interest.

In the obscure cases particular attention should be paid (1) to the extent, character, and relative asymmetry of the tonsillar herniations, and (2) to the degree of prominence of the vermis and the relative widening of its convolutional folia. At secondary operations, because of protrusion, adhesions and surface cavities full of trapped arachnoid fluid, these finer points are necessarily lost and it is important that they should be carefully observed at the primary exposure. At no later session will the conditions be so favourable for a clean-cut enucleation of the growth.

The non-cystic tumors. Though the majority of these astrocytomatous tumors in the cerebellum are in some degree associated with cysts, the lesions of compact type which are more difficult to deal with may deserve primary consideration. They are essentially median lesions which goes to show that the predominantly cystic tumors have acquired their more noticeable asymmetry of position through the tendency of the cyst to expand into one hemisphere more than the other.

In Figure 11 is shown the fairly normal appearing cerebellar surface exposed in Case 69. The uvula, however, was slightly more prominent than normal and there was moderate herniation of the tonsils. The tumor which was wholly concealed and noncystic would easily have escaped detection by the usual exploratory punctures through the lateral hemispheres. The growth, brought to view after incising the vermis at a depth of about a centimeter, was primarily excavated by "scalloping" and its shell was then cleanly brushed from the adjacent cerebellum. Its removal was subtotal owing to the line of attachment along the left margin of the widely expanded ventricle, this residual fringe of the growth having been coagulated by the spray.

In Figure 12 from Case 64 is shown a similarly hidden and much deeper lying tumor which, however, proved not to be wholly concealed. The degree of herniation of the tonsils was such that before they could be liberated a laminectomy of the atlas was necessary. On then drawing the tonsils apart a small nubbin of tumor was visible at the calamus where the posterior end of a medulloblastoma can so commonly be exposed Transection of the vermis was carried to a depth of two centimeters before the tumor

capped by a small cyst, was laid bare. The growth was soft and suckable and was at first mistaken for a medulloblastoma. It was cleanly removed with complete relief of tension as shown (compare Fig. 47) by the marked sagging of the hemispheres from the tentorium. The widened fourth ventricle was fully exposed from calamus to dilated aqueduct.

In Figure 13 from Case 70 is shown a much larger tumor of the same non-cystic type in which the vermis was a little more prominent than in the foregoing case. Here again a laminectomy of the atlas was called for to permit release of the tonsils and on separating them the lower pole of the tumor was similarly brought to view. On then splitting the vermis and brushing the hemispheres to the side the surface of a large, firm, non-cystic tumor was exposed. The extirpation was abandoned short of completion, a shell of the growth having been left overlying the roof of the ventricle.

In Figure 14 from Case 68, an example is shown of one of these median, essentially non-cystic tumors of predominantly fibrillary type which has crowded its way to the surface where it was covered by a thin film of scarcely recognizable nervous tissue and arachnoidea. The posterior end of the tumor, which contained a small localized cyst, projected through the foramen magnum and the arch of the atlas was removed to liberate it. The tumor on scalloping proved to be highly vascular and after a prolonged session the patient's condition forbade further progress. The excavated growth was firm enough to hold sutures which were drawn together to collapse the cavity. It was anticipated that this would facilitate removal at a second session. As a matter of fact, this step merely served so to straighten and elongate the residual portion of the growth that its lower pole was pressed against the medulla by the closure of the wound.

This false step unfortunately was the cause of an early respiratory failure.

Fig. 26. (Case 43.) Patient, aged 11, at time of discharge after first operation. [Ref. p. 162.]

Fig. 27. (Case 43.) The fresh specimen on removal showing effects of surface coagulation. [Ref. p. 162.]

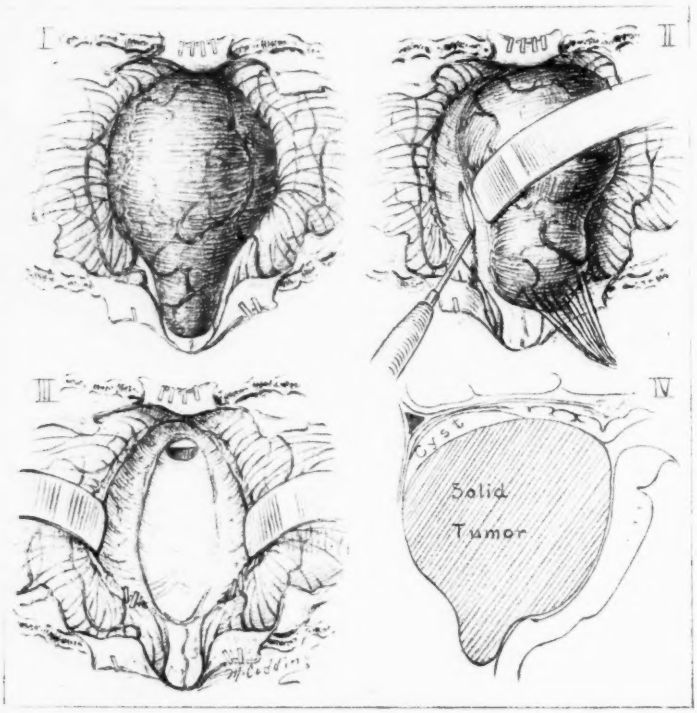


Fig. 28. (Case 43.) Showing condition at second operation (cf. Fig. 25): I, the pear-shaped tumor replacing former cyst; II, dislodgment of growth to side with primary incision into ventricle; III, terminal exposure of widely dilated ventricle; IV, schema of assumed median section of lesion. [Ref. p. 162.]

The autopsy specimen from this case (Fig. 15) makes clear that the excavation was far less complete than was believed at operation. The specimen serves at the same time to give an excellent idea of the size which one of these tumors may attain. The comparatively mild symptoms shown by the patient have already been alluded to in the section on symptomatology. The fact that there had been no preoperative cerebellar rigidities or respiratory difficulty is the more remarkable when one sees to what an extent the entire brain stem has been dislocated forward. At one point, where pressed upon by a non-adherent nodule, the medulla is scarcely four millimeters in thickness.

The lesion in Case 53, shown in Figure 16, was of similar fully exposed type but still larger in extent. The patient was a man 34 years of age with symptoms of long duration. A tongue of the non-cystic and highly fibrillary tumor projected so far into the spinal canal that removal of the arch of the axis as well as of the atlas was necessitated. This sort of spinal extension being far more characteristic of ependymomas than of astrocytomas, the growth when first exposed was considered to be of the former type. The bulk of the tumor was electrically removed but the extirpation was left incomplete for the growth was adherent to the floor of the ventricle in the region of the calamus. Death occurred on the fourth day from peritonitis due to perforative duodenal ulcer.

Relatively small cysts, as shown by some of the preceding illustrations, are frequent accompaniments even of the essentially compact tumors just described. It is rare, in other words, to find an astrocytoma which does not show either on the surface or in its substance some evidence of cyst formation. A few examples of large cysts have already been cited in preceding sections of the text, and as pointed out in connection with Cases 1 and 2, the invariable presence of an underlying nodule of tumor and its actual relation to the cyst took many years to determine. This, which is so important from the standpoint of surgical pathology, deserves re-emphasis here.

The predominantly cystic lesions. These, like the compact tumors just considered, may be wholly concealed or may lie fully exposed to view as in the case of the infant Matthews (Case 61) whose symptomatic story has been told (cf. Fig. 8). In that instance the lesion

lay exposed in the midline; but cysts of comparable size which are concealed differ from the solid lesions in that they are often asymmetrically disposed, and come, for this reason, to be regarded as primarily hemispheric in origin. But even when so lateralized they will be found to extend well across the median line, and should the deeper mesial portion of the cyst-wall happen to be free of tumor the thin roof of the fourth ventricle, flapping with the respiratory movements, can usually be made out at the bottom of the cavity.

As shown in Figure 17 (Case 44), the presence of a concealed tumor was betrayed by a marked tonsillar herniation, more apparent on the left, and which should have been promptly released by removing the arch of the atlas. The vermis itself was without prominence. On transecting the left hemisphere adjacent to it, a large (60 c.cm.) cyst, tumor-lined throughout, was encountered. The tumor which proved to be psammomatous (cf. Fig. 46) was extirpated with difficulty because of its vascularity and the failure to approach it in the midline. The slow formation of an unsuspected postoperative clot was the cause of death at the expiration of twelve hours from sudden respiratory failure. The brain (Fig. 18) furnishes a good example of a large pressure cone, the development of which may have been encouraged in this instance by the fact that the patient had been subjected to a succession of lumbar punctures before his hospital admission.

Fig. 29. (Case 43.) Patient, aged 15, on discharge after secondary operation for removal of large astrocytoma which had replaced original cyst (cf. Fig. 26). [Ref. p. 163.]

But this type of tumor-lined cyst is unusual. It is far more common to find a definitely nodular and well localized area of mural tumefaction. These mural nodules vary greatly in size, some of them being no larger than a lima bean, others as large or larger than a hen's egg. The succeeding sketches will indicate how variable may be the disposition and size of the mural lesions.

In Figure 19, from Case 55, one sees a bulging vermis betraying a central lesion. A large cyst (75 c.cm.) was opened and a small, easily accessible mural tumor was disclosed. The nodule overlay the headward part of the ventricular roof which was necessarily opened in the process of the extirpation. There has been no symptomatic recurrence in this case for nearly three years and none may be expected.

In Figure 20, from Case 54, the external appearances were essentially the same as in the last example but the mural nodule was attached to the upper surface of the cyst wall where from inaccessibility its removal was followed by bleeding from the leptomeningeal vascular attachments to the margin of the incisura, which was difficult to control.

Occasionally the tumors may be multicystic, as indicated in Figure 21 from Case 59, a congeries of "daughter" cysts having been exposed at the base of the large centrally disposed lesion. The tumor nodule was thought to be adherent to the right lateral floor of the ventricle and was incompletely removed.

In Figures 22 and 23 from Cases 66 and 30 are shown examples of what would appear to be laterally placed cystic tumors, one in the left and the other in the right hemisphere. In both instances the conditions were favour-

able for an approach to the mural growth by incision directly through the hemisphere. The relation of the cyst to the fourth ventricle is diagrammatically shown in Figure 22 by the sub-sketch and in Figure 23 by the thin, intact roof of the ventricle which was bulging into the lower part of the cyst wall.

In Figure 24 from Case 62, a less common finding is shown. The prominent vermis betrayed a central lesion and on incising it a 35-cubic-centimeter cyst was widely opened bringing to view a massive laterally placed mural tumor. It was necessary to "uncap" the left cerebellar hemisphere properly to expose this tumor and after its electro-surgical extirpation it was found to contain a large central cyst. In Figure 50 a lesion of similar type is shown.

When the mural tumor occupies a median position (cf. Fig. 8) and is represented by a somewhat flat growth directly implanted on the roof of the ventricle, the surgeon may well hesitate to attempt its removal for the hazards are great and the mere evacuation of the cyst will of itself assure complete symptomatic relief for a number of years. What, however, is likely to happen so as to force his hand at a later session can best be told by the more detailed recital of an experience of this kind.

CASE 43. *Median cerebellar cyst replaced four years later by compact tumor. Extirpation by electro-surgical methods.*

A girl 11 years of age, referred by Drs. R. C. Dodd and Frederick Tilney, of New York, was admitted August 7, 1925, with a history of symptoms of fully seven years' duration.

In 1918 when four years of age, she began having morning vomiting with brief suboccipital headaches and a noticeable unsteadiness of gait. This kept up for six months but ceased following a single osteopathic (*sic*) treatment. After a six months' interval, the attacks returned again and periods of this sort of thing, looked upon as "cyclic vomiting," continued off and on during the next two years.

In June, 1922, the symptoms became aggravated and there were occasional attacks of unconsciousness following severe bouts of vomiting. The symptoms subsequently grew worse, there was diplopia, increase of staggering, and she was found to have a choked disc. By the autumn of 1922 all these symptoms had disappeared and for the next two years, apart from occasional nausea, she was symptom-free and attending school with additional music and dancing lessons. During the autumn of 1924 and the following winter there were occasional reminders of her former attacks and in May of 1925 they returned in full force with blurring of vision, instability, diplopia, nystagmus and a return of the choked disc.

Examination on admission showed a winsome and co-operative child with an enlarged head giving Macewen's sign, a choked disc of 3 diopters with some secondary pallor, a fairly well sustained fine nystagmus, a positive Romberg, and unstable gait with tendency to deviate to the right, definite ataxia with hypotonia and dysmetria of the extremities more particularly of the legs, sluggish superficial and deep reflexes. These symptoms, however, exhibited considerable variability from day to day.

Operation. On August 11, 1925, the usual bilateral-flap exploration was made, great difficulty being encountered from extracranial bleeding. On opening the dura (Fig. 25) a bulging vermis was disclosed with such markedly herniated tonsils that the laminæ of the atlas were promptly removed. A median incision in the vermis brought to view the wall of a large cyst which contained 75 cubic centimeters of sherry-coloured, non-clotting fluid. At the base of the cyst overlying the fourth ventricle was a flat mural growth with a reddish granular surface. The growth proved to be so vascular that only a fragment was removed for histological examination. The walls of the cyst were then fixed by 40 per cent formalin until they became puckered and leathery. A silver clip was closed at one point on the surface of the tumor to serve as the telltale of any subsequent change in the position of the lesion.

Convalescence from this operation was without incident, pressure symptoms were promptly relieved, and the cerebellar signs rapidly diminished. She was discharged on September 2, 1925, in excellent condition (Fig. 26).

Interval history. For the next three and a half years she remained essentially symptom-free, grew rapidly, attended school, engaged in such sports as skating, skiing, dancing, and diving at which she excelled. In May, 1929 the old symptoms began to reappear—slight morning headache, diplopia, and some instability. She re-entered the hospital on June 3 and was found to have a beginning choked disc and unmistakable evidence of recurrence in the cerebellar symptoms. There was no suboccipital protrusion, the old defect having become reossified. The X-ray showed that the clip placed on the surface of the tumor had been pushed outward.

Second operation. June 13, 1929. Under local anæsthesia, on reflecting the original flaps a large, centrally disposed, solid pear-shaped tumor was brought to view. It was sufficiently firm to permit of its holding traction sutures and of being enucleated intact (Figs. 27 and 28), there being only one moment of anxiety in the long four-hour procedure due to bleeding from the anterior tentorial veins which were luckily caught by clips.

There was a sharp postoperative rise in temperature to 106° in three hours, but this was overcome. Though the cerebellar ataxia had been accentuated

by the operation, at the time of her discharge on July 6, 1929, these symptoms were receding and her general condition left nothing to be desired (Fig. 29). At the present time, fifteen months later, there is a residual slight diplopia, some trifling inco-ordination of the right hand, and a little unsteadiness, but she has passed the summer in a girls' camp riding horseback and engaging in the usual activities of girls of her age.

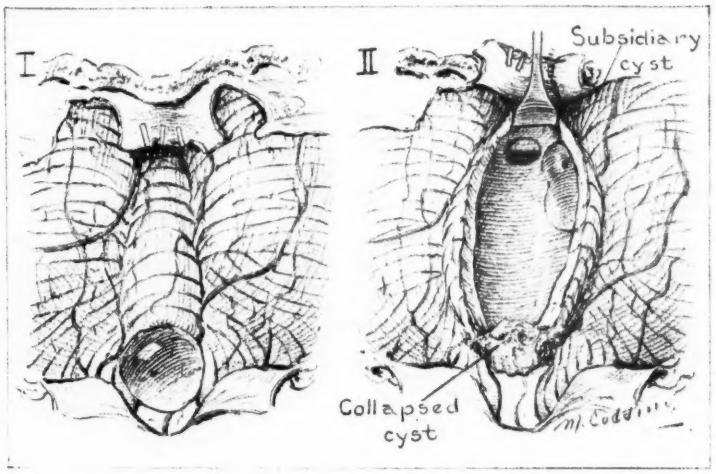


Fig. 30. Symptoms of many years' duration supposedly due to multiple sclerosis. Operation disclosing: I, widely distended vermis with local cyst at situation of calamus; II, enormously distended ventricle with secondary xanthochromic cyst attached to its wall. [Refs. this page and 170.]

Evolution of the cyst. The relation of the cysts to the tumor which has taken so long to determine is sufficiently well illustrated by the examples cited. Certain tumors tend to exude plasma from their surface and the resultant xanthochromic fluid becomes encysted, the cavity becoming lined by a glistening non-absorbing membrane such as quickly surrounds fluid trapped in tissues anywhere. The chemical composition of the fluid shows it to be nothing more than a capillary transudation which may or may not undergo spontaneous coagulation and which varies in colour from a light canary yellow to the colour of sherry wine. That this exudative tendency of the tumors may have something to do with their vascularity is suggested by the fact that hæmangioblastomas are particularly prone to form large cysts. After mere tapping and evacuation, the cyst eventually refills unless the mural tumor has been removed when the formation of fluid ceases even though the cyst wall remains. Hence the membrane does not secrete—only the tumor.

Cavitation through degenerative processes may of course take place within the tumors themselves and cysts of goodly size thus be formed (cf. Figs. 24 and 49), but this is uncommon and cysts wholly within tumors never reach the same magnitude as do enveloping cysts. What is more, they are not lined by membrane and they do not appear to acquire the same degree of tension.

It is of course conceivable that a tumor may wholly disappear through cavitation and ultimate absorption and leave nothing but non-secreting, empty cavities without trace of the original growth. There are two cases in our original series, both of them adults, in whom after many years of symptoms a cerebellar lesion had become symptomatically stationary. In one instance it was an accidental postmortem finding in a patient with acromegaly. In the other, two thin-walled xanthochromic cysts of the fourth ventricle were disclosed at operation (Fig. 30); both were evacuated without disclosing a mural nodule and without in any way whatsoever altering the long-standing mild cerebellar symptomatology. Though both of these cases had come to be incorporated in our series of fibrillary astrocytomas, we have been unable to convince ourselves on restudy of the tissues that they show anything more than some reactive pericystic gliosis—certainly nothing definitely astrocytomatous.

If the tumor has died out in these cases it certainly is not what usually happens. Quite to the contrary, a small mural tumor identified but not removed at a primary operation usually comes in time more or less completely to replace the cyst. Whether the evacuation

Fig. 31. (Case 41.) One of several masses of the large central tumor that was fragmented in removal. Note smooth surface of these lesions as brushed from cerebellum.

of the fluid may have allowed the growth more rapidly to expand, or whether the intracystic tension may tend so to interfere with its nutrient blood supply as to diminish vascularity and discourage its growth, are queries that are unanswerable. The enormous size which may ultimately be attained by the cyst-replacing growth is exemplified by the following case.

CASE 41. A child three years of age, operated upon in October, 1924, proved to have a laterally placed, 80 cubic-centimeter cyst opened by incision in the right hemisphere with only fragmentary removal of the deep-lying, awkwardly accessible mural tumor. Three years later, in December, 1927, for recent recurrence of symptoms a secondary operation was performed with radical extirpation of a huge tumor. The growth was non-adherent and it was removed piecemeal in large masses (Fig. 31), the last fragment having been dislodged from a pocket well above the level of the incisura (Fig. 32). A postoperative fatality from hyperthermia occurred 48 hours later.

One more point should be mentioned before closing this section: namely, that astrocytomas, recurrent after primary incomplete operations, may come to be attached to the floor of the fourth ventricle thereby greatly increasing the hazard of subsequent attempts to extirpate them. This the following case illustrates:

CASE 22. A boy 14 years of age with inconspicuous cerebellar symptoms was operated upon in March, 1921. After negative punctures of the lateral hemispheres a chance tap through the vermis at a depth of 2 centimeters entered a 10-cubic-centimeter cyst which was evacuated.

Eight months later, in November, 1921, he was readmitted because of a return of symptoms with suboccipital protrusion. On re-exploration the cyst was found replaced by a central tumor mass which was incompletely extirpated. The lesion was diagnosed as a protoplasmic astrocytoma and a series of X-ray treatments was given.

After six years of symptomatic freedom, on November 3, 1928, a third operation was performed and a huge recurrent growth was encountered. By this date, the essentially benign nature of the lesion was understood and the attempt was made entirely to remove it. This had to be abandoned short of completion, a single nodule of tumor having been left at the region of the calamus.

Three weeks later, the patient having made an excellent recovery, a fourth operation on November 28, 1928, was foolishly undertaken in the vain hope that the remaining nodule (cf. Fig. 33) might have become dislodged so that it could be removed (cf. the surgical experience in Case 40). This was found to be impossible and resultant bulbar symptoms led to the patient's death five days later.

8. CYTOLOGICAL CHARACTERISTICS

As mentioned in the introductory section, Professor Councilman in the early years of the hospital had taken great interest in the gliomas submitted to his department for diagnosis. In his contemporary highly detailed descriptions with photomicrographs of sections stained by phosphotungstic acid hematoxylin, the tumors we now call astrocytomas, even had we not seen fit to re-examine them by more modern methods during the course of our subsequent review, are so well depicted as to be unmistakable. From the tabular column of contemporary pathological diagnoses for the years from 1913 to 1916, it is evident that he had laid emphasis on the fibrillary character of many of the lesions, but not until after 1923 does the histogenetic type of the tumors begin to be recorded with a distinction drawn in the case of the astrocytomata between fibrillary and protoplasmic varieties (cf. Table of Cases).

Nothing can be of greater value to a surgeon than the ability immediately to visualize from the gross appearances of a tumor what will be its histological nature. Too great

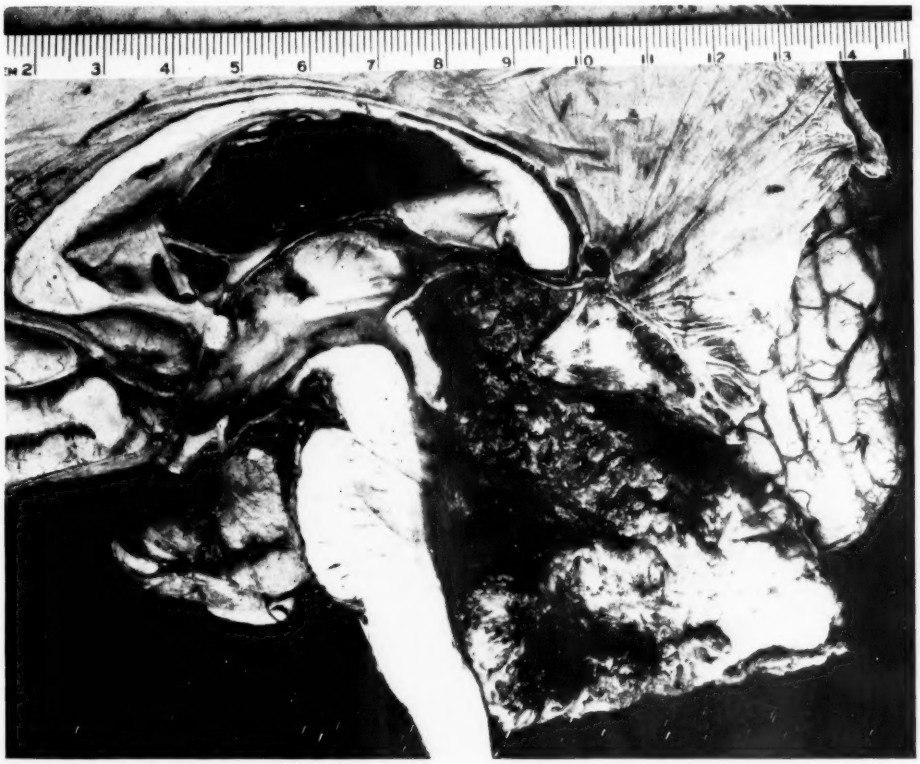


Fig. 32. (Case 41.) To show (nat. size) the right lateral bed of tumor which has extended through the incisura and overlies the corpora quadrigemina. Note: (1) that roof of fourth ventricle has been removed from corpora to vermis; (2) the forward displacement and vertical position of the brain stem; (3) the intact floor of fourth ventricle. [Ref. p. 164.]

emphasis cannot be laid upon this. When, however, dependence was had upon the long delayed pathological reports, which tissue fixation and sectioning and special staining demanded, one's memory of the lesion as seen at operation had become so obscured by intervening experiences and impressions, it was impossible satisfactorily to couple its finer architecture with the appearance in the living. Not until the supravital technique (cf. Fig. 34) came within the past few years to be routinely employed for purposes of immediate diagnosis have our difficulties on this score been largely overcome; and further experience with this technique for purposes of immediate tumor differentiation makes it possible to lay still greater stress upon its value than was justified even a year ago in the discussion of the medulloblastomas. This method, which has been described elsewhere (10), enables one to see the intact cell with its cytoplasmic processes intact and well spread whereas on sections it is mere chance that the cell should happen to lie largely in the plane of the cut tissue. Astrocytes are so characteristic as to be unmistakable either in a fresh smear or in fixed-tissue sections, but those shown by the latter method are so shrunken by fixation they are as different from the living cell as is the raisin from the grape.

From the disposition, external appearance, consistency and other qualities of most cerebellar astrocytomas, we may now, in the majority of cases, make a close guess at the time

Fig. 33. (Case 22.) Brain of patient originally operated upon in March, 1921, when cyst punctured. Six months later partial incomplete extirpation of tumor. Relief for seven years before return of symptoms. Radical extirpation attempted; tumor found adherent to floor of fourth ventricle (arrow). Fatality. [Ref. p. 164.]

of the operation as to what the microscope will show. A large xanthochromic cyst with a definite, fairly firm, sometimes even rubbery mural tumor of low vascularity can hardly be anything else. Indeed, the nature of the lesion may be so unmistakable that when an equivocal report is returned from the laboratory, subsequent study not infrequently settles the matter in favour of the operative diagnosis. The column in the Table recording the presumptive naked-eye diagnoses will show that since the tumor in Case 53 was mistaken in November, 1927, for an ependymoma, the correct anticipatory impression of the cytological nature of the lesion was had in all instances with the exception of the most recent one (Case 76) when at operation the lesion was looked upon as a probable angioblastoma.

Rarely does one meet with a glioma of cytologically pure type. Even in the rapidly growing medulloblastomas, an occasional transition of the primitive cells into spongioblast or even neuroblast may be found on smear (10), on culture (11), or in the sections (12). This is no less true of the astrocytomas in which not only are fibrillary and protoplasmic elements commingled in varying proportions but an occasional oligoglia cell may be clearly demonstrated by supravital technique (10). These rare elements, however, do not modify the pathological diagnosis for the principle of glioma classification is based on the predominating type of cell.

The cerebellar astrocytomata (and the same may be true of the cerebral ones as well though we have not as yet thoroughly restudied the 151 tumors so listed) are in reality

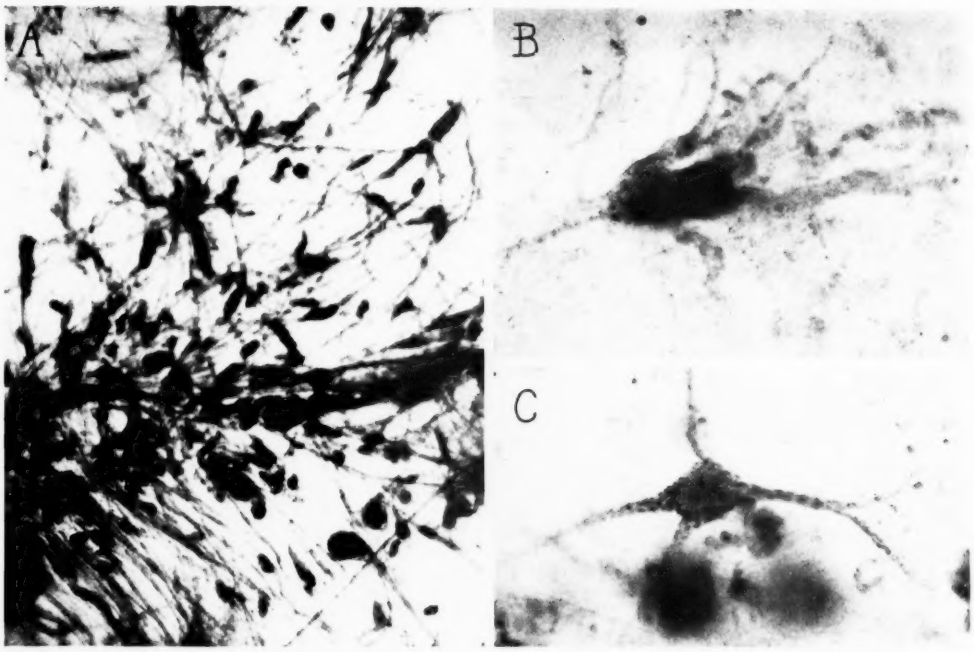


Fig. 34. (Case 68.) A, Supravital preparation of the densely fibrillary astrocytoma shown in Figures 14 and 15 (neutral red stain, × 300). B, Protoplasmic astrocyte (× 850) from same preparation. C, Fibrillary astrocyte in supravital preparation from Case 73. [Ref. p. 165.]

mixed tumors in most of which fibrillary and non-fibrillary astrocytes are found congregated in different areas (Fig. 35). The relative proportion of the two elements can usually be anticipated by the consistency of the lesion as found at operation. The tumor may be as dense as a fibroma and as difficult to "spread" but even when this is so the tangled fibrillary mesh is easily demonstrable (Fig. 36). On the other hand, the growth may be so soft and "suckable" that, in the absence of an accompanying cyst or of tell-tale implantations, it is difficult surgically to distinguish from a medulloblastoma. But these soft, loosely textured tumors composed largely of non-fibrillary (protoplasmic) astrocytes prove to have the same favourable prognosis, if properly treated, as do those in which fibrillary astrocytes predominate, and it is for this reason as stated in an earlier section that we no longer believe it to be necessary or profitable clinically to draw a distinction between them.

The microscope, in other words, cannot tell the whole story and without clinical correlation one may be easily led astray by what it shows. The experience with these tumors is reminiscent of the early attempts by pathologists to classify the acoustic tumors which were variously regarded as pseudo-gliomatous or fibrosarcomatous depending upon the particular portion of the growth which happened to be included in the microscopic preparation, these lesions like the astrocytomata being composed, in varying proportions, of two kinds of tissue differing greatly in architectural appearance. Even in the solid and densely fibrillary tumors of the type grossly shown in Figure 15, there are loosely textured vacuolated areas which are sparsely fibrillary or which may show no fibrils at all (Fig. 37). On the other hand, in not a few tumors, formerly classified as protoplasmic, further sections reveal areas which are either sparsely (Figs. 38 and 39) or densely fibrillary. Case 41 pro-

vides a good example of the latter, the fragment of tumor removed for diagnosis at the primary operation in 1924 having been called protoplasmic whereas the large tumor subsequently removed three years later proves to be about fifty per cent fibrillary (Fig. 40). Only two (Cases 20 and 49) of the nine examples originally classified as protoplasmic are so free from fibrils in the sections as yet studied that they might justify being put in a separate category were it not that they show the same favourable prognosis on removal as do the highly fibrillated tumors. Case 49 which has already figured in the literature may deserve special citation in this respect.

CASE 49. A child eight years of age with the history of morning headaches and vomiting for a period of only six weeks was transferred to us from the Children's Hospital on September 27, 1926, where a 5-diopter choked disc had been found. Examination showed a hydrocephalic enlargement of the head and there were definite though inconspicuous signs including nystagmus pointing to a cerebellar lesion.

At operation on September 30 a highly vascular condition of the extracranial tissues was found necessitating early puncture of the hydrocephalic ventricle before the exposure of the cerebellum could safely be proceeded with. After removing the thin suboccipital bone and reflecting the dura, the lower pole of a median tumor was seen projecting between the tonsils down through the foramen and a laminectomy of the atlas was made in order to liberate it. A central, pear-shaped tumor covered by a thin sheet of cortex was then exposed (Fig. 41 A). Because of its highly vascular surface it was mistaken for an hæmangioblastoma. It was found to be non-adherent at the situation of the calamus where the lesion was partly cystic and a small fragment of the cystic tissue was removed for histological examination. It proved to be sclerosed cortex.

The child made an excellent recovery with subsidence of all symptoms and was given a series of six X-ray treatments and discharged on October 28. By March of the next year headache and vomiting had begun to reappear and there was bulging of the suboccipital region. Her readmission was advised and with the newly introduced electro-surgical methods, it was hoped the tumor could be safely attacked. The growth, possibly in consequence of the radiation, was found at this session after shrinking by surface coagulation to be sufficiently firm to be easily manipulated. It was removed *in toto* (Figs. 41 and 42) with the usual wide exposure of the fourth ventricle.

From this operation the patient made an excellent recovery (Fig. 43) and remains symptom-free now three and a half years later. The tumor after fixation and sectioning proved to be an astrocytoma composed almost wholly of protoplasmic elements, only an occasional fibril being evident in the single block which has been cut (Fig. 44).

Other secondary features of these slowly growing tumors which may deserve mention are the tendency to hyalinization of the blood-vessels (Fig. 45) and the occurrence of spotty calcification (Fig. 46) which in one instance led consequently to the roentgenological diagnosis of tuberculoma.

9. DIFFERENTIAL DIAGNOSIS

This has necessarily been touched upon from its several aspects, clinical, surgical and pathological, in preceding sections. From a symptomatic standpoint a medulloblastoma tends on the whole to be much more rapid in onset and on the average to occur at an earlier age than the other types. In a recent case a medulloblastoma with spinal metastases has been verified by the finding of tumor cells in the cerebrospinal fluid, but this could scarcely be advocated as a routine measure for it is quite possible that the puncture would serve to dislodge cells from an intact tumor and disseminate them through the cerebrospinal spaces.

Attention may be called to the fact that, in view of the inconspicuous local symptomatology there may be difficulty in distinguishing between the hydrocephalus due to a tumor of the third *versus* tumor of the fourth ventricle. This uncertainty was recorded for Case 30 but most of the third ventricle lesions of childhood are congenital cysts arising from relics of Rathke's pouch and they usually show calcification. Another source of diagnostic error less likely to occur today than formerly is due to the failure to detect the presence of a concealed and deeply seated midcerebellar lesion. This has led (e.g., Cases 28 and 36) to the diagnosis of pseudo-tumor or chronic arachnoiditis in case the wall of the posterior cistern was found to be greyish and appeared thickened.

Roentgenotherapy might conceivably be called upon as a diagnostic aid in view of the known effect of the X-ray in temporarily checking the growth of a medulloblastoma.

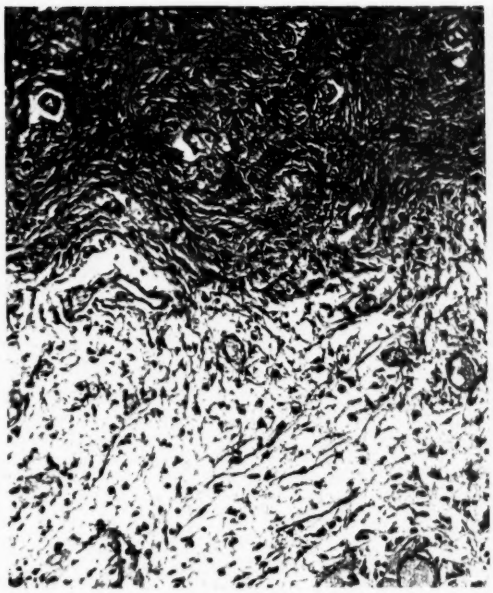


Fig. 35. (Case 33.) Showing, in same section, densely fibrillary area in sharp contrast with œdematous sparsely fibrillary area (P.T.A.H. × 150). [Ref. p. 167.]

Fig. 36. (Case 77, not in series.) The dense felt-work of fibrils in a rubbery astrocytoma difficult to "spread" (supravital preparation, × 850). [Ref. p. 167.]

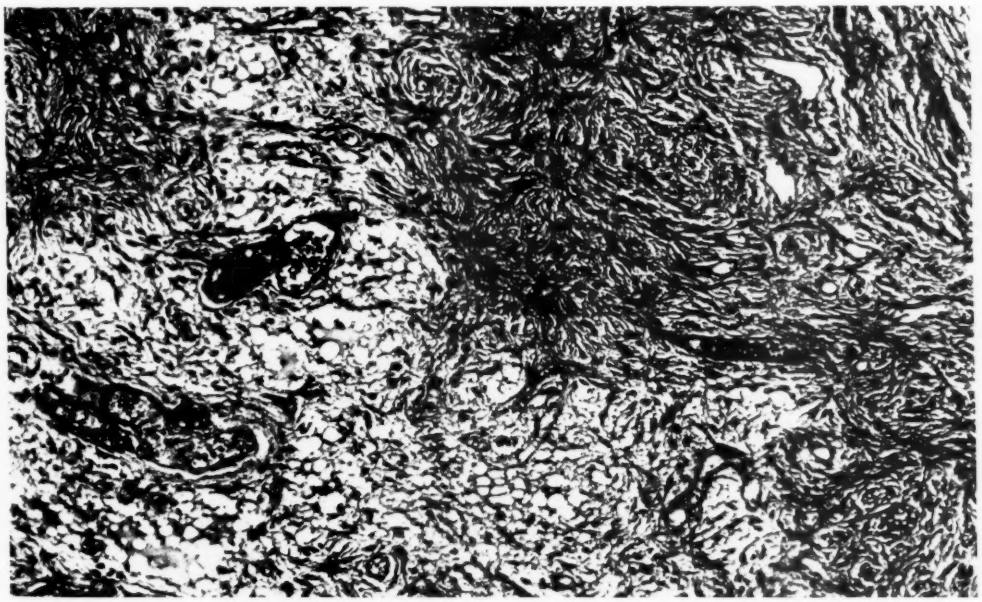


Fig. 37. To show the architectural appearance of the densely fibrillary astrocytoma from Case 68 shown in Figure 15 (P.T.A.H. × 150). [Ref. p. 167.]

This recourse, however, would hardly serve the purpose of distinguishing between the two lesions in view of the known spontaneous remissions in the symptoms of an astrocytoma. Moreover, serious risks may be attached to the procedure. When there is a definite history of headache and vomiting with more or less notable remission over a period of years, one may feel reasonably sure he is not dealing with a medulloblastoma.

The lesions with which a cerebellar astrocytoma is likely to be confused when exposed at operation are the medulloblastomas, the ependymomas, angioblastomas, and possibly the papillomas which frequent the same midcerebellar region. A percentage basis would speak in favour of an astrocytoma for in our series they occur in the proportion of 76 to 62 medulloblastomas, to 22 angioblastomas, to 18 ependymomas.

In the case of median tumors that are unassociated with cysts or in which the cystic formation is relatively inconspicuous, and particularly when the tumor is relatively soft and easily "suckable" as we say, there may be doubt as to its nature, many astrocytomas being sparsely fibrillary. On the other hand, in the medulloblastoma report (2) examples were given of tumors that were sufficiently firm to be enucleated more or less intact. In short, the median cerebellar astrocytomas may be so soft and free from cysts as to suggest a medulloblastoma (e.g., Cases 45 and 50), so vascular as to suggest an angioblastoma (e.g., Cases 49 [cf. Fig. 44] and 76), or so disposed as to resemble an ependymoma (e.g., Cases 34, 42 and 53 [cf. Fig. 16]). The Table will show how often the operative diagnosis was misjudged in the past, and how free from errors it has been since the nature of the lesion in Cases 49 and 50 was misjudged.

An erroneous pre-operative diagnosis of tuberculoma was made in one instance (Case 71) by the roentgenologist on the basis of spotty calcification in the subtentorial region detected stereoscopically on the X-ray films, but the clinical history and examination served to make it improbable. Calcification in the subtentorial region is difficult to detect and it has been observed only in this single instance though a number of the tumors have shown calcification on microscopic examination. It, moreover, is common in the cerebellar ependymomas and too much stress for purposes of pre-operative differential diagnosis cannot be laid upon it.

Two other conditions may deserve mention. One of them is what is called chronic cisternal arachnoiditis which probably corresponds to what was once called pseudo-tumor cerebelli for these conditions are apt to provoke symptoms that are suggestively cerebellar; it, however, is not a common condition in childhood though the Table will show that Case 28 after the primary operation was so diagnosed. The other condition may possibly be best designated as congenital cystic malformation with occlusion of the foramen of Magendie. In one instance of this sort in a child the preoperative diagnosis of astrocytoma was made and at operation a small thin-walled cyst similar to that shown in Figure 30 was found.

10. PHYSIOLOGY

Whereas localization of function in the cerebrum is of the utmost importance in determining the locus of its tumors, the same cannot be said of the cerebellum in spite of the most elaborate studies. We may often determine the laterality of tumors and may distinguish between primarily extracerebellar and primarily intracerebellar lesions. We may at times also make a close guess as to whether the lesion is essentially median in position and presumably by the predominance of vomiting in the symptomatology whether the brain stem is under compression, which it usually is in these midline tumors.

It has been learned that a surprising amount of cerebellar tissue can be experimentally removed from an animal without permanent disability and the customary "uncapping" of the cerebellum to get a satisfactory exposure of the familiar acoustic tumor is followed by no discernible subsequent instability unless the excision is made deep enough to damage the dentate nucleus or the peduncles. And as will be seen from the description of the operations for these astrocytomas, the vermis may be vertically split throughout its length so as fully to expose the fourth ventricle with no symptomatic trace of this radical procedure.

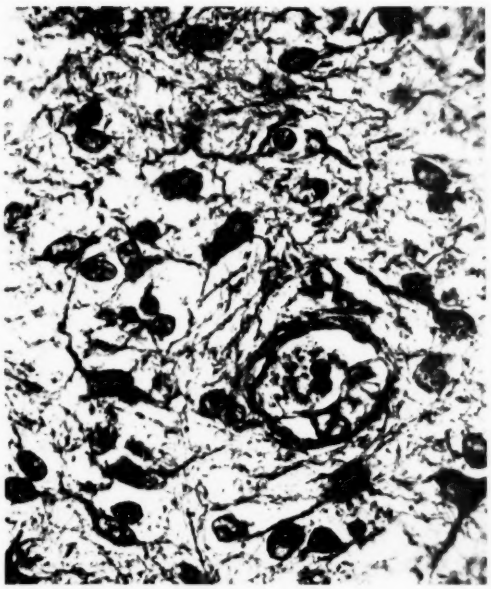


Fig. 38. (Case 40.) Sparsely fibrillary area in tumor which was formerly classified as protoplasmic (P.T.A.H. × 600). [Ref. p. 167.]

Fig. 39. (Case 22.) Sparsely fibrillary area from soft tumor showing single fibrillary astrocyte with stumpy processes (P.T.A.H. × 600). [Ref. p. 167.]

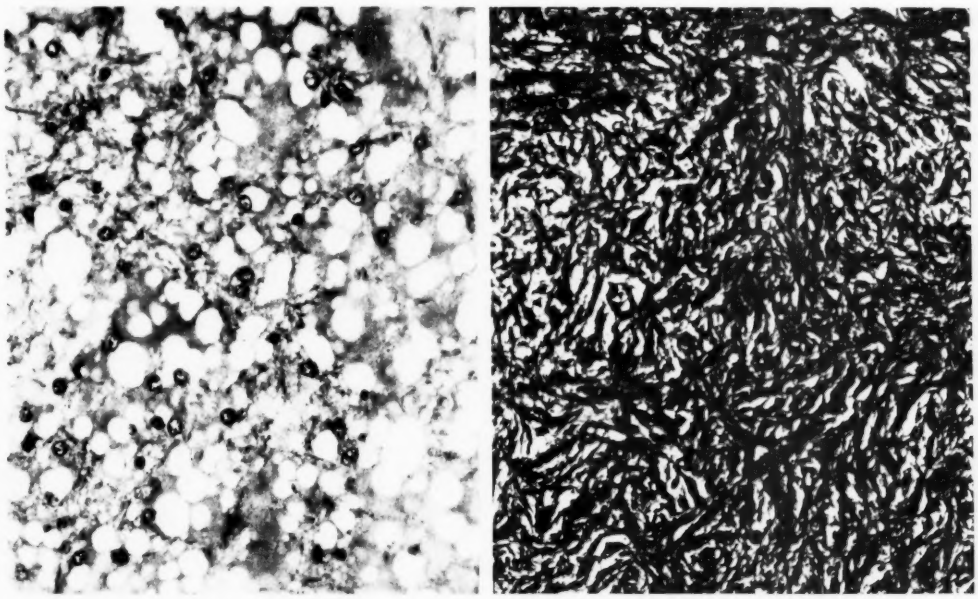


Fig. 40. (Case 41.) Fields from different areas of a typical mixed astrocytoma classified as protoplasmic from a small fragment removed at primary operation. Purely protoplasmic, left; densely fibrillary, right. [Refs. pp. 167-8.]

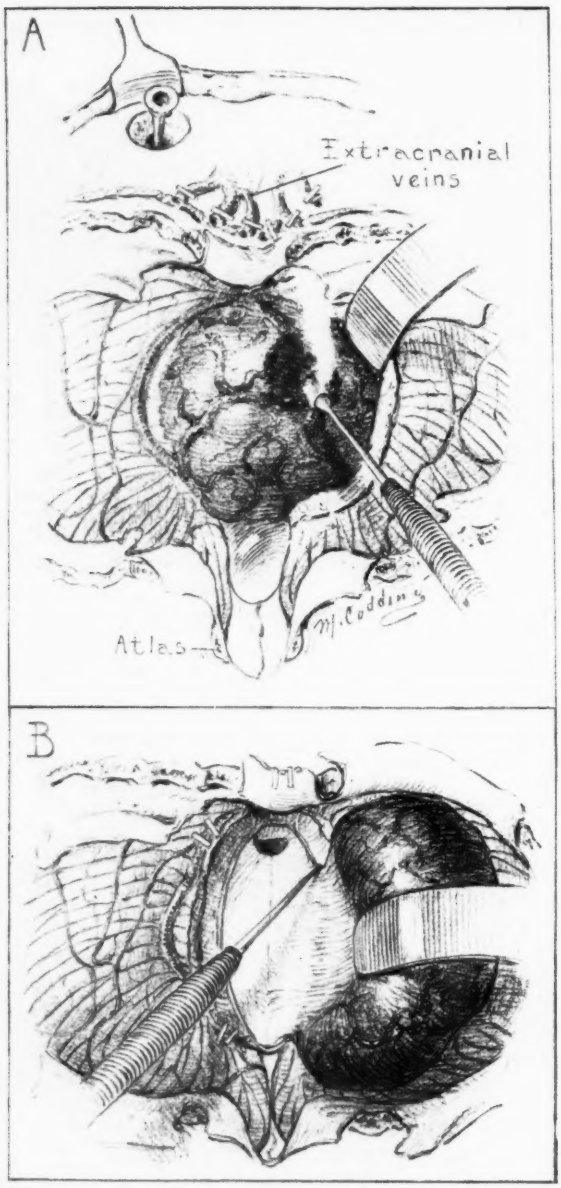


Fig. 41. (Case 49.) Showing: A, field at first operation in 1926 when a supposedly angioblastic tumor was exposed and its surface coagulated; B, the electro-surgical removal of the intact tumor at a second operation seven months later. [Ref. p. 168.]

Fig. 42. Tumor from Case 49 supposedly an angioblastoma, shrunken by coagulation before removal (nat. size). [Ref. p. 168.]

What is more, after the removal of huge recurrent cerebellar tumors little may be left but a mere shell of cerebellum and yet it may suffice for all practical purposes of equilibrium and muscle tone.

Nor as a matter of fact, apart from an interest in cerebellar physiology, does exact localization or even lateralization of the lesion make a vast degree of difference to the surgeon since there is only one satisfactory way of surgically exposing the cerebellum and that is from behind and below the level of the lateral sinuses, the precise situation of the lesion being determined by a close scrutiny of the surface configuration for distortions, by abnormal vascularity, by palpation and exploratory punctures. The subtentorial fossa is so comparatively small that an intracerebellar tumor of any sort and situation may exert pressure effects that are evenly distributed and apart from the possibly greater inco-ordination of legs over arms or of one side over the other, preliminary localization is scarcely determinable nor from an operative standpoint is it greatly needed. The particular tumors under discussion, in spite of their associated cysts which may bulge more markedly into one hemisphere than the other, are essen-

Fig. 43. (Case 49.) Showing patient on discharge after second operation. Note depilation from six months of ineffective radiation (1926–1927); also absence of protrusion. [Ref. p. 168.]

tially median in position and the chief matter of neurophysiological interest is the fact that nystagmus may be inconspicuous or absent even though ataxia, which particularly affects the lower extremities, be of extreme grade.

That much might be learned of cerebellar function through the study of these cases by a physiologist whose interest lies in the nervous system goes without question; and the fact that a knowledge of their morbid anatomy rather than neurophysiology has to do with the successful treatment of these tumors should not be taken to mean that the opportunity of advancing knowledge of cerebellar function should be neglected.

II. THERAPEUTIC CONSIDERATIONS

The brief notes in the Table under the caption "Operative Procedures" serve as milestones of our therapeutic progress, successive modifications in the surgical manœuvre having been necessitated as our knowledge of these particular tumors grew. Several periods correlated mainly to contemporary views of tumor pathology may be recognized. The dates will show when emphasis was laid almost wholly upon the cyst which was punctured and evacuated, or laid open and treated by some tissue fixative, or in favourable circumstances excised; when it began to be apparent that recurrences were inevitable and it was found that the cysts were apt to be replaced by tumor; when the effort to identify the tumor for purposes of classification became a routine; when radiotherapeusis was given a trial; and finally, after the relatively benign nature of the lesions became apparent, when the importance of removing the mural nodule intact at the first session began to be appreciated. These several periods have been punctuated also by successive improvements in technique and it can be seen when ventricular punctures in course began to be used; when local anæsthesia was first employed, when the suction apparatus came into general use; when it came to be realized that the tumors were primarily median in position and overlay the fourth ventricle so that even when concealed they were best approached by a median transsection of the vermis; and finally when electro-surgical methods came to simplify enucleation and hæmostasis.

Radiotherapeusis. Soon after the war, we began more or less routinely to subject pa-

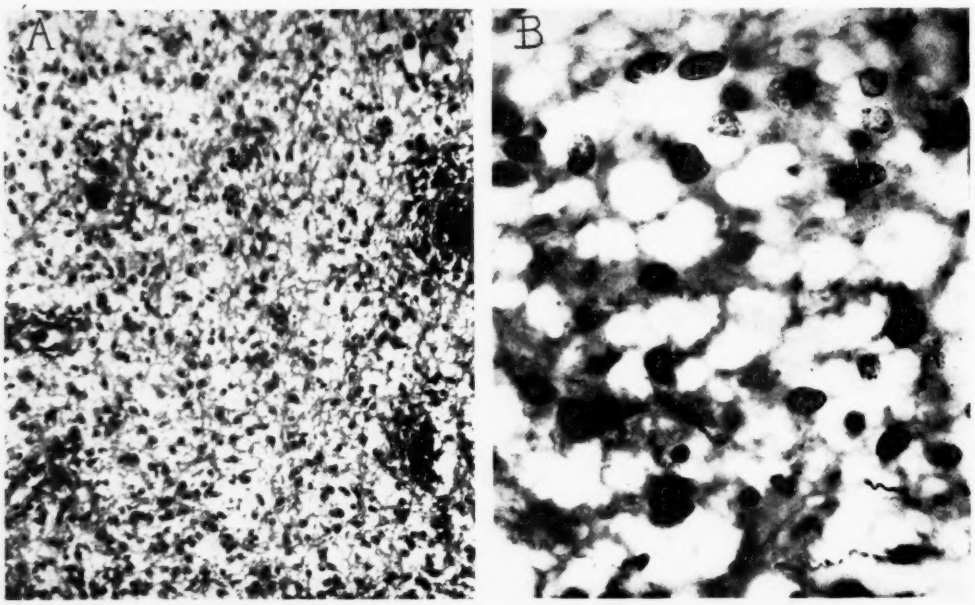


Fig. 44. (Case 49.) Vacuolated astrocytoma almost wholly protoplasmic. A, To show character of the lesion (× 150). B, Higher magnification (× 600) showing sparse fibrils in lower corner of field. [Ref. p. 168.]

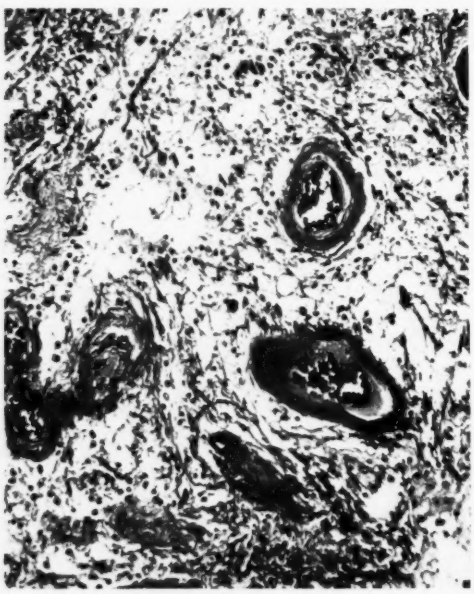


Fig. 45. Showing, in Case 72, characteristic hyalinization of blood vessels which in some tumors is very pronounced. [Refs. pp. 168 and 188.]

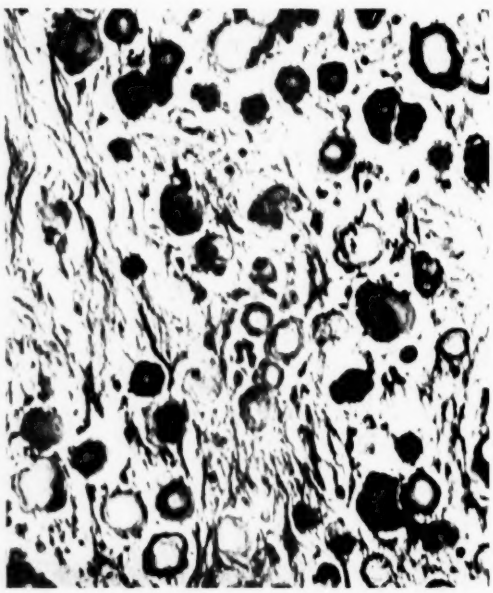


Fig. 46. Showing, in Case 44, the spotty calcification often seen in these tumors and occasionally detected by the X-ray. [Refs. pp. 161 and 168.]

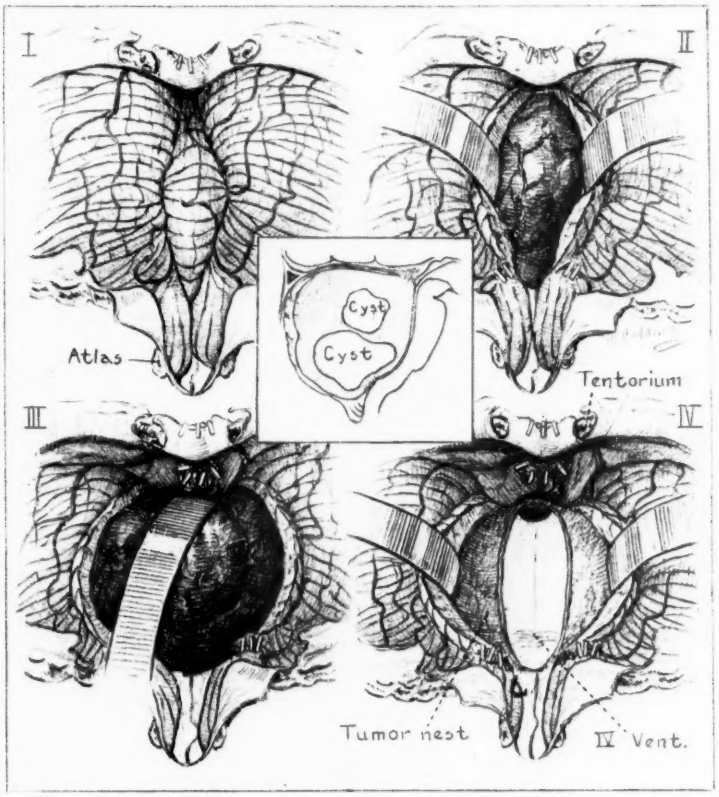


Fig. 47. (Case 71.) Showing: I, the posterior cerebellar surface with prominent vermis; II, the tumor exposed after median incision of vermis; III, stage of difficult dislodgment from tentorium; IV, appearance of field at conclusion of operation with sagging hemispheres and edge of incisura exposed. Insert shows (cf. Fig. 49) the assumed lesion in sagittal section. [Refs. pp. 185–6.]

tients to therapeutic radiation after operations which had served to demonstrate the presence of a glioma. The results on the whole were looked upon as encouraging. The treatments at least did no harm and in the face of what was thought to be, at best, a malignant growth, they gave us a therapeutic straw to lean upon. Similar steps were being taken in other places and ere long articles were published advocating preliminary radiation before resorting to surgical intervention. The risks of so doing are now well known. Radiation of a tumor, when effective, caused swelling of the growth and increased symptoms which may prove fatal in the absence of a decompression. What is more, without some assurance of the histological nature of the lesion, from which alone some idea could be gained of its prognosis when unradiated, the presumed effects were capable of misinterpretation. This is particularly true of tumors such as those under consideration whose symptoms are prone to show spontaneous remissions.

Gliomas which had been surgically verified and decompressed offered a more favourable opportunity to observe the effects of roentgenization, and the matter during the next several years was thoroughly put to the test by Dr. M. C. Sosman, the hospital roent-

Fig. 48. (Case 71.) Patient on discharge 20 days after operation. [Ref. p. 187.]

genologist. From the notes in the last column of the Table it can be seen that during 1922–1924 (Cases 22–50) the patients with these cerebellar astrocytomas were commonly radiated, as was true of other verified gliomas. The susceptibility of the medulloblastomas to this form of treatment soon became apparent and for reasons now better understood the astrocytomas were long thought to be beneficially influenced. In September, 1927, a conjoint report of these experiences was given by Sosman, Bailey, and Van Dessel before the American Roentgen Ray Society (13). The conclusions then expressed were that roentgen therapy at best merely exercises a restraining influence on the more malignant types of glioma, more particularly on the medulloblastomas, to a less extent on the glioblastomas; and, as was stated, some improvement had also been obtained with the protoplasmic astrocytomas whereas the more slowly growing tumors, notably the fibrillary astrocytomas, remain uninfluenced.

This conservative statement would about represent our present-day views with the inclusion of the more protoplasmic with the fibrillary types (at least of the cerebellar astrocytomas) for we would no longer think of subjecting even them to radiation. It will be seen from the Table when our enthusiasm for this supplementary treatment began to wane. Cases 45 and 50 were so treated (and with presumed benefit) but that was partly because the lesions were mistaken at the time of operation for medulloblastomas and there was delay in getting a pathological report upon them. Cases 46 and 48 were also radiated from some misunderstanding; and Case 49 for the reason that the lesion was mistaken for an angioblastoma, a type of tumor somewhat amenable to roentgenization.

That a cerebellar astrocytoma, whether predominantly fibrillary or predominantly protoplasmic, is wholly unaffected by radiation is at least something learned to lighten the labour of the roentgeno-therapeutic department. Without a knowledge of the natural history of the tumor, regarding it simply as a glioma and consequently a lesion of malignant character, the results in many instances might well enough have been misinterpreted as triumphs of radiotherapy.

Pre-operative therapy. Owing to the peculiarly insidious progress of these mid-cerebellar astrocytomas, patients are apt to enter the hospital in an advanced stage of the process with seriously impaired vision, and a few days' unnecessary delay may mean blindness. If delay is unavoidable, recourse is had to salinization, preferably in children by magnesium sulphate enemata. The value of this procedure in lowering intracranial tension particularly when there is hydrocephalus cannot be overemphasized, and it is not uncommon for bedridden and vomiting children to be up and playing about in a day or two so free from symptoms as utterly to belie the seriousness of their plight.

It has already been pointed out that intract-

able constipation is a customary complaint due partly to the fact that straining at stool for obvious reasons greatly exaggerates the headache. Caution should be given at the same time against the giving of large enemata. Nothing could be more dangerous for a patient in the stage of the malady in which cerebellar rigidities or actual (Jacksonian) seizures occur, than to be propped up on a bed pan and obliged to evacuate in this position an enema which causes uncontrollable peristaltic straining. Death has occurred under such circumstances in two (e.g., Case 15) instances and in earlier days when it was customary to give a preoperative enema not a few patients had serious cerebellar seizures inopportunely provoked thereby on the morning set for operation.

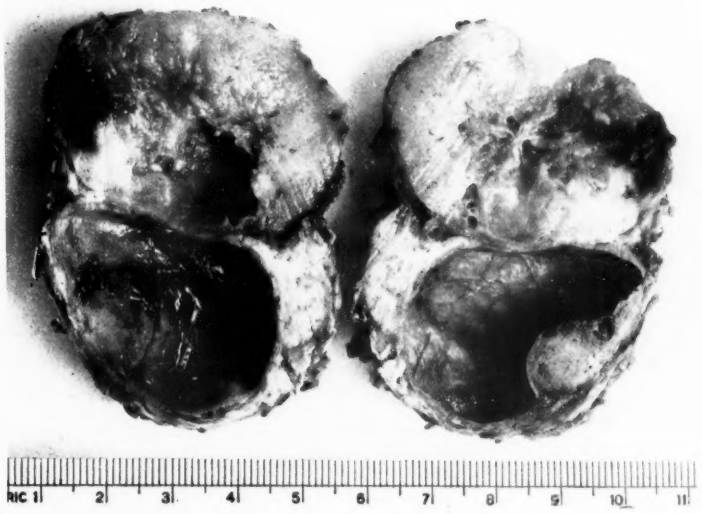


Fig. 49. (Case 71.) The 51 gram tumor (nat. size) after transsection showing cystic cavities (cf. Fig. 47). [Ref. p. 187.]

Another thing to be avoided and against which attendants are warned is the possibility of twisting the patient's head into a painful position in the process of shaving the scalp preparatory to the operation. A cerebellar seizure may sometimes be the consequence of this, and it is therefore wise in critical cases to carry out the shaving after the patient is in the comfortable face-down position on the operating table.

The anæsthetic. Most neurosurgeons have come round to what de Martel first strongly insisted upon: namely, that most cerebellar as well as other intracranial operations of other types could and should be carried out under local anæsthesia. It is remarkable how well patients, even young children, will endure these long procedures with scarcely any complaint worth recording. Not only does inhalation narcosis vastly increase the difficulties from extracranial bleeding encountered in the preliminary stages of the operation, but it is highly dangerous from the standpoint of respiratory embarrassment particularly when the symptomatology of one of these fourth ventricle tumors is at all advanced.

It is our custom in most intracranial operations to give a preliminary dose of 0.3 milligrams of scopolamine with 10 milligrams of morphine shortly before the operation with another 5 or 10 milligrams of morphia in course if it is called for; but even this, when there is impaired respiration, may be precluded. The Table will show that since April, 1926, twenty-one of the operations have been conducted wholly under novocain infiltration. In another ten operations, restlessness or complaints or inco-operation on the part of the children have made it necessary to tide over difficult periods with temporary etherization. This we have occasionally given per rectum, but we usually prefer to use the rectum for a continuous Murphy-drip during the long session, a thousand cubic centimeters or more of fluid thus being given.[1]

[1] We have recently had occasion to use avertin per rectum with highly satisfactory results in patients who may be intolerant of local anæsthesia alone. The drug acts directly on the sleep center in the third ventricle.

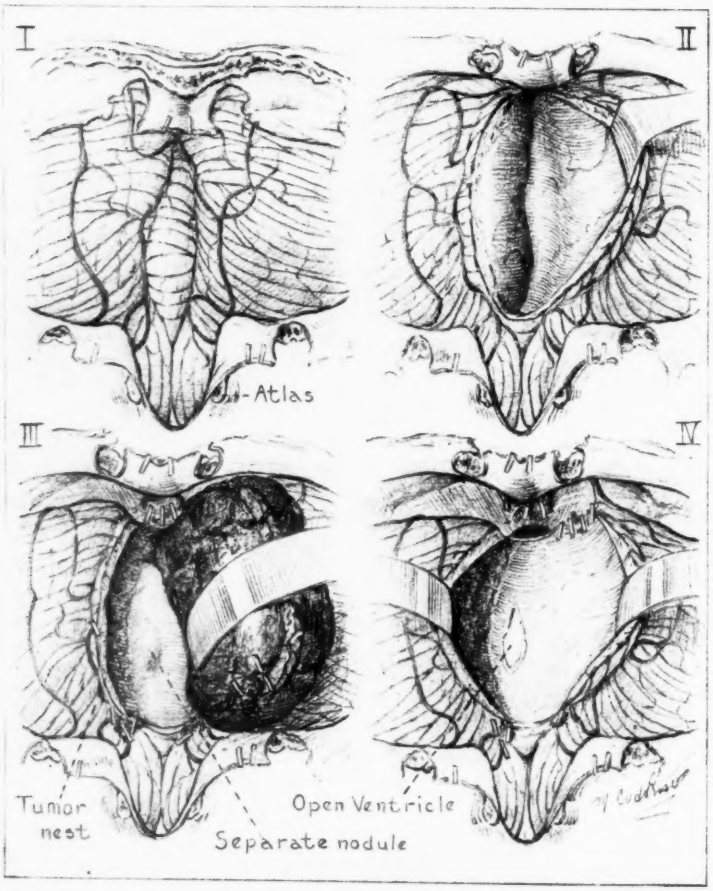


Fig. 50. (Case 72.) Operative sketches showing: I, the bulging vermis and marked pressure cone extending almost to the arch of the atlas; II, the lesion after primary exposure, its right half cystic, its left solid; III, the removal of the solid portion from its nest in left hemisphere without opening the ventricle, disclosing small separate nodule; IV, the final appearance of the field with small opening into ventricle and sagging hemispheres (that on the right hanging by an anchoring vein), permitting full view of tentorium to margin of incisura. [Ref. p. 187.]

The cerebellar exposure. By good fortune as long ago as 1904 a satisfactory operative method had been hit upon of getting a wide bilateral exposure of the posterior face of the cerebellum. In one way or another this procedure has been simplified and perfected but in its essentials it remains as first described (14). As it is commonly referred to in the Table merely as the usual or customary procedure, something more may be said of it here, for though "the operation proper" is represented by what is done after the cerebellum is once exposed, the method of approach and the method of withdrawal are essential parts of the procedure and may be exceedingly difficult and tedious.

It is, indeed, an adage of the operating room that "a cerebellar case takes an hour to get in, another to get out, and plenty of time between"—the "time between," usually a

Fig. 51. (Case 72.) The patient three weeks after operation. [Ref. p. 187.]

matter of an hour or two, may sometimes be extended to three or four. And should there have been sufficient uncertainty of localization to have made a preliminary ventriculography advisable—a measure we hesitate to resort to in critical cases such as these unless we are prepared to operate immediately afterward—this means pretty much a full day's work. Consequently to gain time for other things I have come of late years to relay most of these operations with my skillful associate, Gilbert Horrax, who does the larger part of the getting in and getting out while I take over the dealing with the lesion.

The postoperative photographs of the patients that accompany the few more detailed case reports that have been picked out for illustration will show the usual situation of the "cross bow" incision we continue to employ. It is not an operation for a tyro, and some neurosurgeons have recently advocated the return either to a vertical incision or to the old low, transverse incision, neither of which in my opinion gives adequate room for the critical manipulations to follow. The attempt to turn down a bone flap in this muscularly well protected region is wholly unnecessary and can only serve to incommode subsequent manipulations.

The linear part of the incision, which should be precisely in the ligamentum nuchæ, is highly advantageous as one never knows when it may be necessary, owing to an extreme pressure cone or to an actual extension of the tumor through the foramen magnum, to laminectomize the atlas. This, as noted in the Table, was carried out in seventeen cases in the series and doubtless would have been beneficial in others (e.g., Cases 4, 19 and 44); and in consideration of the fact that the

Fig. 52. (Case 72.) The attached surface of the tumor nodule after removal (nat. size). [Ref. p. 188.]

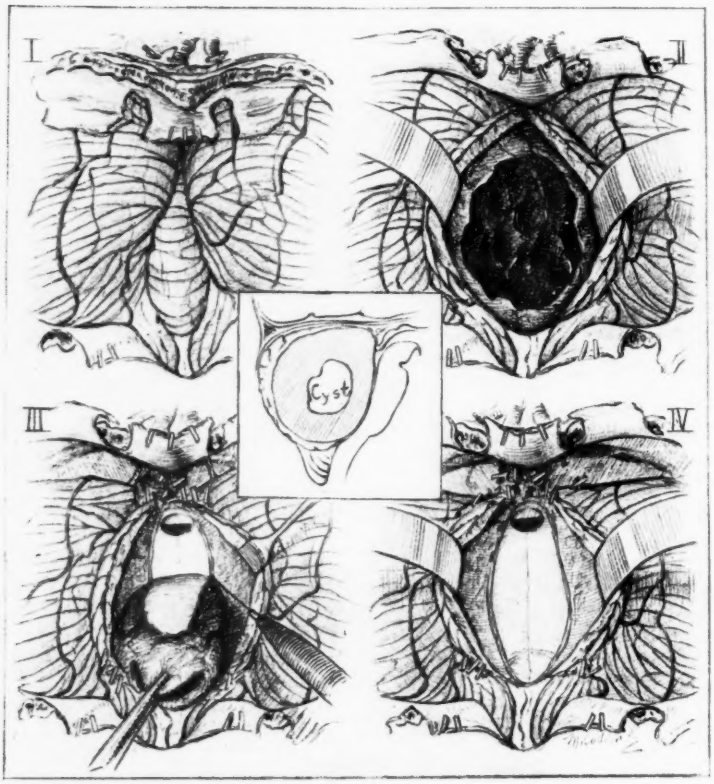


Fig. 53. (Case 73.) Operative sketches showing: I, the bulging vermis and mild tonsillar herniation; II, the tumor after primary excavation; III, the residual fragment being withdrawn together with roof of ventricle; IV, the resultant cavity with abundant clips shown above sagging hemispheres where vascular tentorial attachments had been torn. [Ref. p. 188.]

purpose of the laminectomy was to release a dangerous pressure cone it is significant that only two of these complicated operations led to a fatality. In Case 53, removal of the laminæ of the axis as well as of the atlas, as will have been observed (Fig. 16), was necessarily carried out before the lower pole of the tumor could be liberated.

The curvilinear incision from mastoid to mastoid makes possible the wide reflection of the lateral flaps needed for the exploration of the lateral recesses when that is necessary, gives room for the "uncapping" of a hemisphere, when for the proper exposure of an awkwardly placed tumor this is called for, and permits sufficient lateral separation of the hemispheres to give access to the deeper parts of the vermis without needless contusion.

Care should be taken in reflecting the curved flap of scalp downward to identify the margin of muscular attachment, a thin edge of which should be carefully preserved for subsequent suture in layers, for otherwise spurious meningoceles may form under the flaps. The repair of a wound in which this had occurred led to one of the fatalities in the series (cf. Case 54). The extracranial venous stasis produced by the intracranial tension, which inhalation narcosis serves to accentuate, may not infrequently give serious trouble so soon as the muscle begins to be scraped from the bone in process of reflecting the lateral flaps. Waxing may fail to control this and early recourse must sometimes be had to a ventricular puncture which greatly improves the situation by lowering tension. And with the needle left in position, excessive protrusion of the hemispheres, when the dura comes to be opened, is avoided and their subsequent manipulations are less likely to cause disagreeable symptoms. This device, first put into practice in 1909, has since become common property and it is but one of many similar steps so commonly employed as scarcely to deserve mention.

As a matter of fact, this preliminary emptying of the cerebral ventricle is disadvantageous in one respect for it may so lower tension in the posterior fossa that surface indications of

a deep, median, wholly subcortical tumor are effectually concealed and may be overlooked. This happened, as the Table records, at the first operation on Cases 4, 10, 11, 28, and 36, the last experience of the kind having been in September, 1923. The lesion in the succeeding forty cases, even though concealed, has (with the exception of Case 59) been brought to view and verified at the first session.

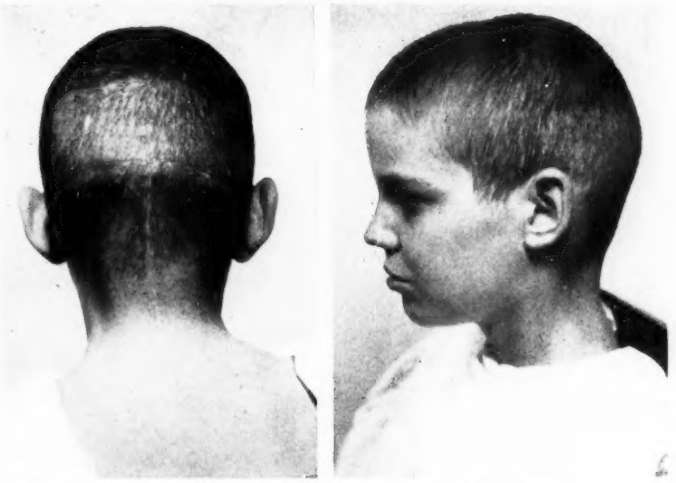


Fig. 54. (Case 73.) To show condition of patient when discharged on the eighteenth postoperative day. [Ref. p. 188.]

What is of chief importance, as emphasized in the section on gross pathology, is the close scrutiny of the widely exposed posterior surface of the cerebellum. There is of course no difficulty in locating the lesion when a portion of the tumor is visible on the surface, or when there is marked hemispheric asymmetry, or when palpation discloses a cyst. But when there is perfect symmetry as there often may be with a deep median, non-cystic lesion, the relative widening of the vermis is about all that one has to go upon. And should tension have been wholly relieved by escape of cerebrospinal fluid and the cerebellum have settled back into its normal position, it not only takes conviction to incise the vermis but one may have to carry the incision down a centimeter or two before the surface of the tumor, which may prove to be surprisingly large, is actually reached.[1]

The surgical procedure is far more simple when there is a large cyst which bulges into one hemisphere more than the other, for even if not palpable its presence will often be betrayed by the hemispheric asymmetry and unmistakably widened convolutions. In earlier days, as the operative notes in the Table betray, we were led into making transverse incisions into these laterally placed cysts, but we have come more and more to feel that in the majority of cases a vertical incision through the vermis is the preferential way of opening most of them if one is to attack the underlying mural tumor with the greatest promise of success.

The crux of the operation, as is now fully realized, lies in the removal of the mural nodule at the first operative session when its situation and the patient's condition makes the step permissible. These mural tumors are most variable in size and position. When superficially or laterally placed, they can be removed, even though of large size, with comparative ease from the wall of the cyst, at the base of which can usually be seen the flapping roof of the fourth ventricle a few millimeters in thickness. But when the mural tumor is in the depth and occupies the portion of the cyst wall corresponding to the ventricular roof, its removal is attended with much greater difficulty and hazard. Mural tumors that are situated in the midline high under the tentorium offer another particularly difficult problem for the reason that the vascular attachments from the posterior margin of the incisura to the leptomeninges are apt to be torn, and bleeding in this highly inaccessible region is exceedingly difficult to control (cf. operative history of Case 73, p. 188). A fatality

[1] Apparently the first time this was done deliberately was on August 25, 1922, Case 33.

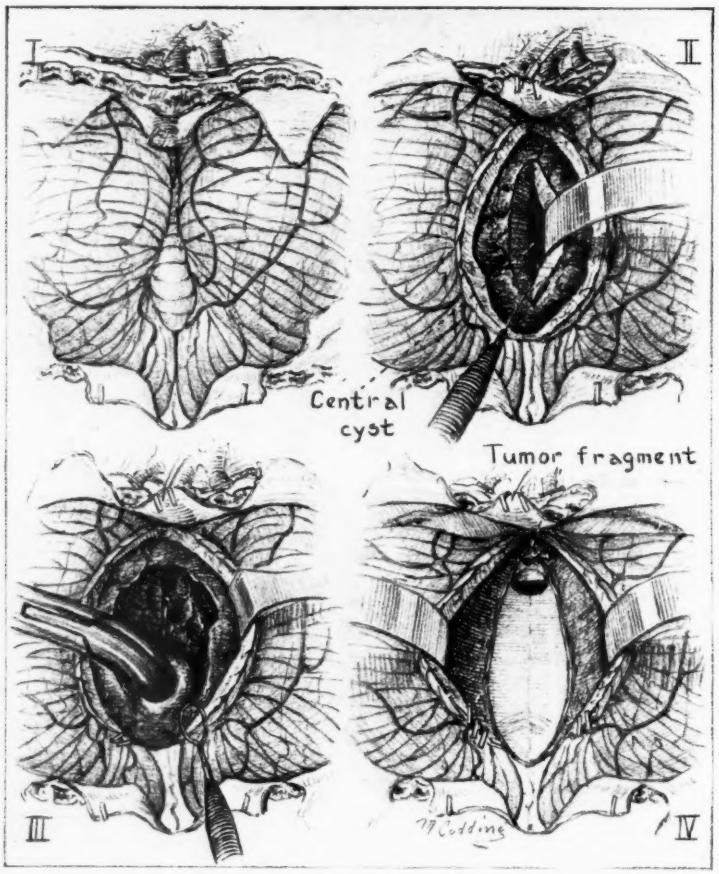


Fig. 55. (Case 74.) Operative sketches showing: I, the exposed cerebellar field with slightly prominent uvula and moderate pressure cone; II, transsection of tumor after partial exposure; III, method of piece-meal removal; IV, final exposure with residual tag of coagulated tumor in dangerous region near incisura. [Ref. p. 188.]

occurred in Case 51, at a second operation after an otherwise highly favourable procedure, due to the postoperative formation of a clot from this source.

But if these difficulties exist, after the evacuation of a large cyst has not only completely lowered tension but has provided ready access to the lesion, they are vastly increased when a solid central tumor is encountered. In dealing with these cases, the surgeon's judgment is put to the greatest test and whether or not a total extirpation should be attempted must depend on circumstances which relate to the degree of vascularity of the growth and one's facility in controlling it, to its relative "suckability," to the evidence or otherwise that the growth is unattached to the ventricular floor, to the patient's general condition, and to many other factors.

There are two particularly critical points of vascularity, the one at the calamic region where branches of the posterior cerebellar arteries go to the choroid plexus of the region, the other at the aforementioned incisural margin of the tentorium. The operative sketches will possibly serve to

make some things more clear than the written word.[1]

It is important to complete the operation if possible at the first session. We were at one time encouraged to feel that a two-stage procedure might be desirable and that the lesion might become extruded. This impression came about from the experience with Case 40 in which, during the repair of the muscle incision due to the formation of a pseudomeningocele, the cerebellar hemispheres were reseparated and a residual fragment of tumor, which was thought at the first session to be irremovable because of its position, was found almost wholly dislodged and it was picked out of the wound. But this is not likely often to happen. It was found impossible at the secondary operation under similar circumstances in Case 54 even to bring the residual fragment into view and the patient was lost from a streptococcus meningitis.[2]

Fig. 56. (Case 74.) Showing condition of wound on discharge. [Ref. p. 189.]

On other occasions (cf. Case 49) I have left an operation incomplete after opening a large central cyst leaving, from lack of courage, a flat mural tumor on the roof of the ventricle in the hope that the subsequent accumulation of fluid would tend to push the growth outward. This is not what occurs under these circumstances. On the early reexposure of a cerebellum after previous transsection of the vermis and evacuation of a large central cyst, it is difficult to believe that there has ever been a lesion present for the formerly separated hemispheres have folded themselves together and the widely exposed growth has become completely concealed.

Enough has been said in a previous article (17) regarding the usefulness of electro-surgery as an adjunct to intracranial operations. It may be re-emphasized after an interval of three years that it is now possible safely to eradicate many brain tumors that a few years ago would have been regarded as inoperable. Apparently the first case in the present series in which this surgical adjunct was put to effective use was in the handling of the tumor in Case 49 in its two sessions (Fig. 41). In the treatment of a vascular brain tumor the intelligent use of a sucker, the employment of silver clips and the electro-surgical apparatus are (with the minor aid of muscle implantations and Zenker-wet cotton pledgets) in my estimation of about equal importance.

Postoperative therapy. This may be briefly dismissed. Patients are routinely left with their position unchanged on the operating table with a provisional dressing applied until they have fully recovered from the immediate effects of the procedure. This is particularly important should it have been necessary to give an inhalation narcosis or should the patient be nauseated, for the face-down position is one in which there is the least risk of an

[1] It is customary for the surgeon to make sketches of the operative stages as he recollects them immediately at the conclusion of the procedures. No written description is of equal value, however crude the sketches. It is impossible for an artist to get near enough to the field with the patient in prone position for a direct view. The drawings accompanying the paper have been worked up by Miss Codding from the originals on the hospital histories eked out in some of the more recent cases by her own fleeting glimpses of the field.

[2] This and another cerebellar case in a child (No. 54) in the medulloblastoma series both succumbed to a hæmolytic streptococcal infection at a time when the community and the hospital staff were suffering from an epidemic of sore throats. They represent the only examples of infection in the series and were probably contaminated by the operator himself who though not ill was found to be harbouring organisms in his throat. The masks then in use were found to be insufficient.

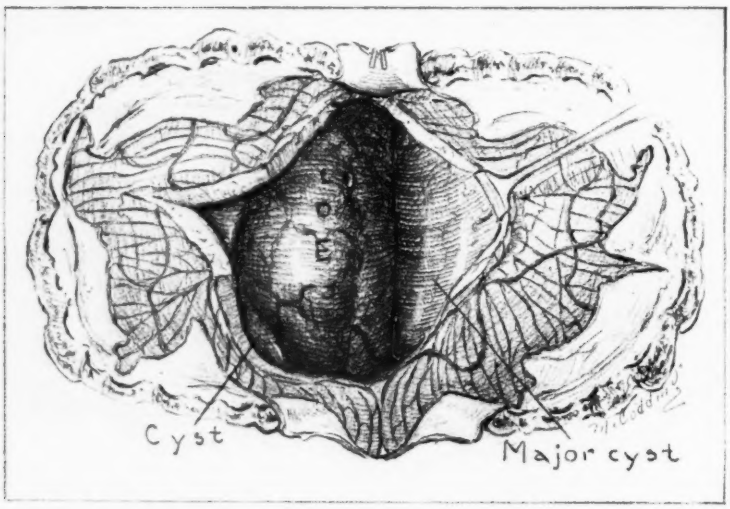


Fig. 57. (Case 75.) Showing the general appearance at operation after exposure of a sausage-shaped tumor capped by bilateral cyst. [Ref. p. 189.]

accident from vomiting. When conditions are critical and there is any impairment of respiration, they may be kept in this position for twenty-four hours or more and the instrument table is kept in readiness for immediate reopening of the wound should at any time there be a suspicion that a clot may have formed. The rectal temperature should be taken as soon as possible when the operation is concluded and frequently repeated in order that a tendency to hyperthermia should be promptly detected and measures for controlling it by antipyretic drugs or by sponging be applied.

These are the principal immediate precautions. Later complications in serious cases may require no less detail and we no longer venture to transfer critical cases of this sort to other than the expert care and undivided attention of a specially trained nurse. Deglutitory disturbance after wide exposure of the fourth ventricle may make feeding highly precarious and nasal feeding may sometimes be necessary for days. One feature of the convalescence of the patient, while the cerebrospinal fluid remains blood-stained, is the periodic occurrence of waves of pyrexia which sometimes call for a succession of lumbar punctures until the fluid has cleared. When punctures should be made and how much fluid can be safely removed takes experience and judgment. Attention to all these details is what in the long run greatly affects the operative mortality. The surgical procedure itself, important though it be, is by no means the whole story.

Mortality percentages. However brief the notes, the Table will show that many of the fatalities in the early years would today have been avoidable had we then known what we now know of the site, nature, and life history of these peculiar tumors. Even so, in consideration of the complicated nature of the operation and of the fact that from ignorance we were so often obliged because of return of symptoms to grapple with the always more difficult and hazardous secondary operations, the fourteen postoperative deaths for the 113 cerebellar operations on the 75 cases[1] is perhaps no more than one might justly expect.

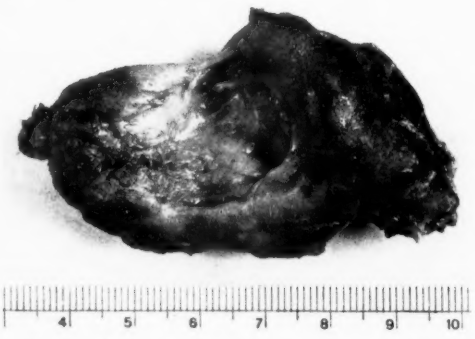


Fig. 58. (Case 75.) The cystic side of the mural tumor as removed at operation (nat. size). [Ref. p. 189.]

[1] No cerebellar operation was undertaken on Case 6.

This gives for these particular tumors a surgical case-mortality of 18.6 per cent and an operative mortality at various hands of 12.4 per cent.

The effect of repeated operations on the operative mortality is shown by the fact that in the 75 primary explorations there were only six fatalities, namely, 8 per cent, whereas there were five fatalities out of 28 secondary operations (17 per cent), two fatalities in eight tertiary operations (25 per cent) and one of the two patients (Cases 7 and 22) that had four cerebellar operations succumbed as a result of the last of them which was a highly inadvisable undertaking.

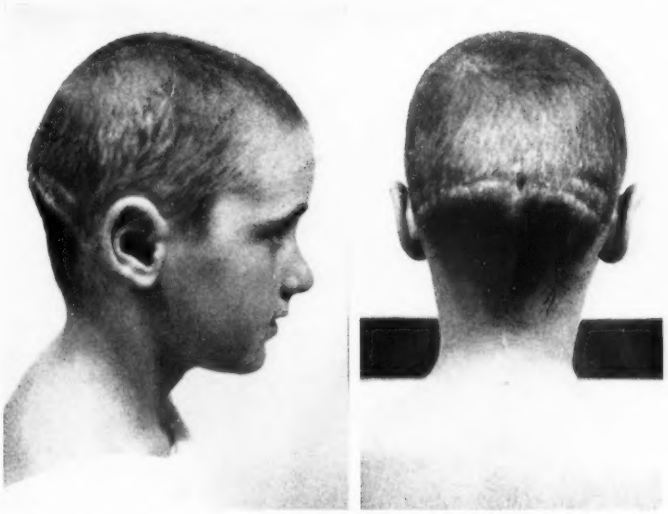


Fig. 59. (Case 75.) To show patient and condition of the wound at the time of discharge three weeks after operation. [Ref. p. 189.]

The causes of death in the fourteen fatal cases have been respiratory failure in five instances (Cases 1, 21, 44, 47, and 68), hyperthermia in three (Cases 13, 22, and 41), meningitis in two (Cases 3 and 54), pneumonia (Case 33), postoperative clot (Case 51), perforative duodenal ulcer (Case 53), and the sudden unexplained death on the sixteenth day that occurred in Case 19. Could someone, profiting by the knowledge we now have slowly acquired regarding these tumors and the preferential way of treating them, have the opportunity of reoperating on precisely this same series of patients, the case mortality could well be held within 5 per cent, and secondary operations would be few and far between. An indication that this might be so is shown by the figures for the series of 23 successive cases admitted since January, 1928, there having been only one fatality, namely Case 68, with the large solid tumor of which so much has been made in preceding sections.[1]

To give a better idea of the surgical problem and the way it has been met in these later-day patients, a brief report of the operative findings of the last few may properly be subjoined.

Case 71. A neglected Polish child, 10 years of age, promptly referred by Dr. E. P. Lothrop of Buffalo, gave a history of former matutinal headaches and vomiting which had ceased about seven months ago, of clumsiness at play for six months, of blurring of vision for five months, of double vision and extreme instability for three months, and of blindness for three weeks.

Examination showed a bedridden, hydrocephalic, blind child with a choked disc of 5 diopters and cerebellar ataxia so marked as to make tests for station or gait impossible. No nystagmus was observed beyond a few occasional ill sustained fine twitches. The deep reflexes were diminished with accompanying muscular hypotonicity. Shadows of slight calcification in the right cerebellar fossa were detected on the X-ray films leading the roentgenologist to suspect a tuberculoma. The clinical diagnoses favoured astrocytoma over medulloblastoma.

The operation. This was conducted wholly under local anæsthesia, the child behaving admirably throughout the four-hour procedure. The usual cross-bow incision with lateral reflection of flaps, puncture of lateral ventricle and removal of the suboccipital bone was completed without noteworthy incident. On opening the dura (cf. Fig. 47), a bulging vermis was disclosed with such marked tonsillar herniation an immediate laminectomy of the atlas was performed. The vermis was then electrically incised in the midline through the entire

[1] With the five cases that have been successfully operated upon with tumor enucleation since the tabular list was made up, there would be a series of 28 consecutive operations with a single fatality, giving a 3.6 per cent case-mortality, which is about what we should expect in the future.

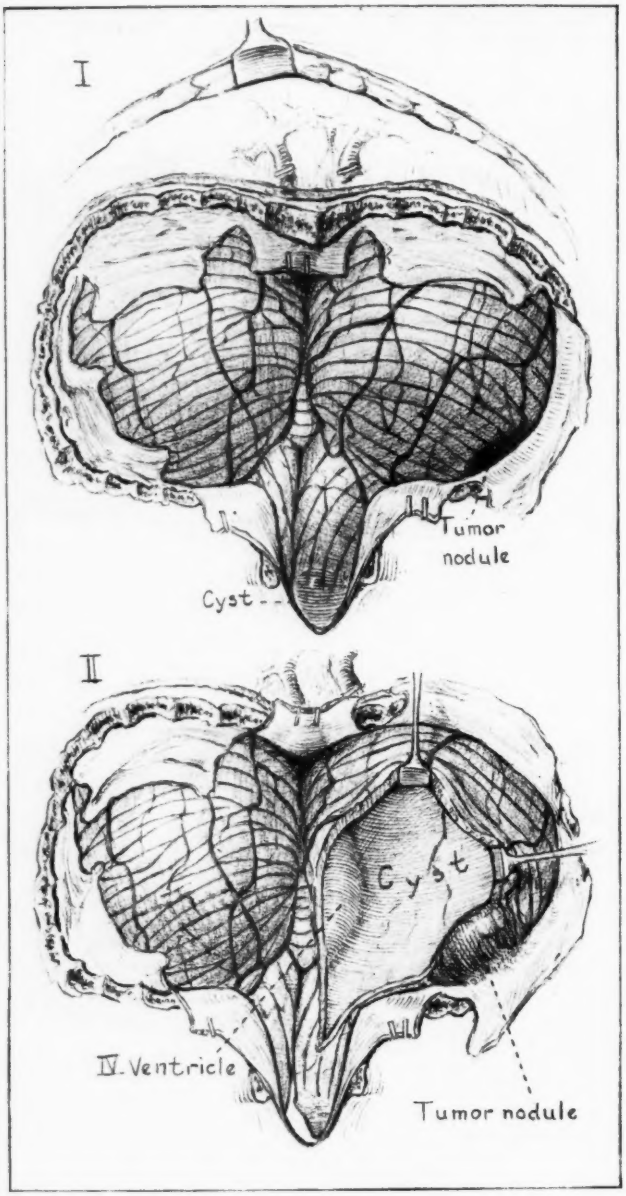


Fig. 60. (Case 76.) Operative sketches showing: I, the marked tonsillar herniation with cystic tip on the right; II, the opened cyst with bulging floor of fourth ventricle and laterally disposed tumor nodule. [Ref. p. 190.]

5 centimeters length of the exposure, a greyish, soft, partly median tumor being disclosed, its lower portion palpably cystic. A needle was inserted into the cyst and 30 cubic centimeters of promptly-clotting clear xanthochromic fluid were withdrawn. The large tumor which lay headward to this cyst was soft on palpation and suspecting another cyst a needle was introduced into it and 10 cubic centimeters of blackish blood-stained fluid were withdrawn without collapsing the growth.

The tumor was easily separated from the cerebellar hemisphere on each side, most of the dissection being made with the cutting needle. No particular difficulties were encountered until the stage of freeing the upper surface of the tumor was reached. There was little but a thin film of cortex and vascular leptomeninges separating the growth from the tentorium and this was soon torn into with troublesome bleeding from two or three good-sized spurting vessels in the region of the incisura. These were fortunately controlled by suction and caught with clips. The branches from the posterior cerebellar arteries entering the growth at the region of the calamus having been secured earlier in the operation, the remainder of the enucleation which necessitated removal of the ventricular roof together with the large growth was completed with the aid of electrical dissection, as shown in the sketches, without undue difficulty. The completely separated cerebellar hemispheres by this time were sagging from the tentorium with only a few points of vascular anchorage. The huge cavity was filled with salt solution and after the usual toilette with painstaking hæmostasis the flaps were drawn together and closed in successive layers by rows of buried interrupted fine black silk sutures.

Postoperative notes. There was an early postoperative rise in temperature to 104° F. but this promptly subsided on sponging. On the following day 45 cubic centimeters of blood-stained fluid were removed by lumbar puncture. This was repeated on the third day; and as the temperature continued to range around 102° and the suboccipital region was somewhat full, on the sixth day the

site of the tumor was punctured and 110 cubic centimeters of bloody fluid not under tension were withdrawn. The patient meanwhile made excellent progress; she was walking fairly well at the end of two weeks and at the time of discharge (Fig. 48) on the twentieth day the choked discs were flat and she was on the road to a complete symptomatic recovery in all respects except for the blindness.

The tumor. A fragment, submitted to Dr. Eisenhardt for examination so soon as the growth was exposed, showed a fibrillary growth with many small astrocytes, and it was in this case that isolated oligodendroglia cells were identified on the fresh smears. The subsequent sections confirmed the diagnosis of a moderately fibrillary astrocytoma and give added information of spotty calcification. The tumor (Fig. 49) was of large size and weighed with empty cyst 51.6 grams.

Fig. 61. (Case 76.) The patient two weeks after operation showing flat suboccipital region. [Ref. p. 190.]

Though, in the next case, the growth (cyst included) was about the same size as the foregoing, its enucleation was facilitated by the fact that about half of the space-occupying lesion was cystic and the solid portion was fortunately unattached to the roof of the fourth ventricle.

CASE 72. A twelve-year-old Italian school girl, referred by Dr. F. X. Mahoney, of Boston, gave a history of early morning headache and vomiting for a period of only three months; but the anamnesis records an attack of whooping cough three years previously during which she acquired a strabismus of the right eye that was subsequently corrected in part by an operation. For six months a faulty posture had been observed; for two months she had been growing awkward in her movements; for one month the gait had been staggering; recently there had been blurring of vision.

The examination showed a frail child with manifest hydrocephalus, a choked disc of 6 diopters, a paresis of the right internal rectus, and an advanced cerebellar syndrome (in the absence of nystagmus) with marked hypotonicity of the musculature and slightly hyperactive deep reflexes.

Operation. This, a five-hour performance, was carried through wholly under local anæsthesia after a preliminary 7 milligrams of morphia. The customary cerebellar exposure was made, the hydrocephalic left ventricle having been tapped in course. The posterior cerebellar surface showed (Fig. 50) a bulging vermis with greatly widened folia, its tip extending below the level of the foraminal opening. There was a marked tonsillar pressure cone including the lower leaflets of the hemisphere necessitating a laminectomy of the atlas and dural incision to the arch of the axis before the cord was exposed.

The vermis was then split laying bare the wall of a large cyst from which 60 cubic centimeters of quickly-clotting xanthochromic fluid were withdrawn provoking an attack of vomiting. To the left of this cyst lay a hemispheric tumor extending from calamus up under the tentorium. It was electrically separated from its nest in the left cerebellar hemisphere and was removed by tilting it to the right, the usual difficulty being encountered (as in Case 71) in freeing the growth from its vascular attachments to the anterior tentorium, the posterior margin of the incisura being fully exposed.

Up to this point the roof of the fourth ventricle which was bulging into the deeper part of the cyst had not been opened. However an additional small tumor nodule was seen overlying the ventricle and in electrically excising this a small opening was made into the cavity. The separated cerebellar hemispheres by this time sagged markedly away from the tentorium, that on the right being hung by a single large anchoring vein. The great cavity was filled with salt solution and the wound was closed in the customary detailed way.

Postoperative course. This was without incident. There was a febrile reaction to 102° F. which slowly subsided. No punctures were called for. The choked disc slowly subsided without impairment of vision. She was discharged (Fig. 51) at the end of a month

walking fairly well and when examined six weeks later had become essentially symptom-free.

The tumor. The nature of the growth was apparent at operation and the supravital study confirmed the diagnosis. Subsequent sections taken from the mural tumor (Fig. 52) showed a typical densely fibrillary astrocytoma with characteristic hyalinization of the blood-vessels (cf. Fig. 45).

The next case presented a surgical problem similar to that of Case 71 but there was no superficial cyst to facilitate the extirpation and the tumor was removed piece-meal in the hope of avoiding the risks of hæmorrhage from tearing the high tentorial veins of anchorage, an object not attained.

CASE 73. A twelve-year-old school boy referred by Dr. Maurice Brien of Lewiston, Maine, gave a ten months' history of occasional attacks of morning vomiting and occipital headache following a fall on the head. For one month he had had periodic dizziness, diplopia, tinnitus, and stiffness of the neck. He had recently found some difficulty in balancing on his bicycle. He had been at school until three weeks before admission.

Examination showed a healthy-appearing lad with a rather large head giving a Macewen's sign on percussion, a choked disc of 4 diopters with beginning atrophy, slight occasional nystagmus, a positive Romberg and some instability in gait. The degree of inco-ordination was slight.

The operation. This was conducted wholly under novocain without preliminary drugs. The exposure of the cerebellum (Fig. 53) was made without undue difficulty, the hydrocephalic ventricle having been punctured in course. The vermis was widened and there was a pressure cone but the tonsils could be withdrawn after opening the posterior cistern without the need of an atloid laminectomy. The wholly concealed, greyish, tough tumor was brought to view by the usual median incision. The growth after partial electrical separation from the hemispheres proved to be fully as large as that shown in Figure 49. In the process of attempting to enucleate it the tentorium soon became exposed and fearful of getting bleeding from the anchoring veins a piece-meal excavation of the lesion was begun. A cyst of considerable size was encountered in the center of the growth and this facilitated the procedure.

Everything went well until at the last moment of separating the tumor's anterior pole an anchoring vein must have been torn and blood began to appear in the subdural space around the hemispheres. A coincidental attack of vomiting complicated the situation but I managed to get the bleeding checked by pressure of a cotton pledget inserted between the tentorium and leptomeninges while the rest of the upper pole of the growth was quickly removed by rongeurs and suction. On then removing the pledget serious bleeding started afresh and the blood-pressure dropped off markedly before bleeding was again temporarily controlled by another implanted pledget. Preparations were made for a transfusion, and muscle for implantation was taken from the patient's gastrocnemius. Strips of muscle were then worked in between the tentorium and the pledget until it could be removed. It was a close call.

The patient meanwhile had been given 250 cubic centimeters of blood from a donor. It was finally possible to attack the remaining and lower portion of the growth and to draw it downward, the lateral margins of the ventricular roof, which came with it being electrically divided. The wound was then closed with the usual detail. The boy behaved superbly throughout the long five and a half hour procedure.

Postoperative course. Apprehending a possible complication from a postoperative clot, the patient was not removed from the operating table for several hours. Convalescence as a matter of fact was surprisingly uneventful. There was an early rise in temperature to 103° which promptly subsided. The dressing was done on the fifth day when a lumbar puncture was made withdrawing 60 cubic centimeters of xanthochromic fluid. This was repeated three days later. The choked discs had subsided by the tenth day leaving vision somewhat impaired in one eye only. He was discharged on the twenty-third day (Fig. 54) practically symptom-free.

The surgical difficulties encountered in the operation described above were reflected in the more conservative way in which a month later the lesion in the next case—another non-cystic median tumor of the same type and size—was treated.

CASE 74. An eleven-year-old school boy from a country district was referred by Dr. F. G. Jones of Utica, New York, as an urgent case because of failing vision. There had been a history of occasional headaches and vomiting extending over a period of more than two years. For one year there had been periods of blurred sight and occasional attacks of (cerebellar?) unconsciousness. For three months the gait had been unsteady.

The examination showed evident secondary hydrocephalus, choked discs of 3 diopters with beginning secondary atrophy. There was unsteadiness of station and gait but the cerebellar signs were not marked. A well sustained nystagmus was present. The long history made the diagnosis of an astrocytoma probable.

The operation. This, a five-hour procedure, was performed wholly under local anæsthesia with a preliminary dose of 0.8 milligrams of morphia. The cerebellar exposure (Fig. 55) was difficult owing to the huge emissary vessels communicating with the bone and scalp in the torcular region necessitating an early puncture of the ventricle, the fluid being found under great tension. This, however, did not

serve greatly to lower subtentorial tension for the cerebellum protruded on opening the dura. The vermis was not particularly prominent but on electrically incising it to a depth of possibly 4 millimeters, the smooth greyish surface of an unmistakable astrocytoma was brought to view.

After this tumor had been more fully exposed it was electrically transsected, a central, *circa* 20 cubic-centimeter cyst (as in Case 73) being encountered, the tension of the tumor being definitely lowered by its evacuation. The tumor proved to be of such large size that it was deemed inexpedient with what was rather an inadequate exposure to attempt its removal intact. Masses of the growth were then picked up with rongeurs and cut off with the cutting loop. This was followed by suction and scalloping until the size of the growth was so reduced it could be drawn away from the roof of the ventricle which was fully opened by the electric needle as the final mass was removed. From the region of the incisura above the greatly dilated iter, there hung a fringe of tissue that looked suspiciously like residual tumor. Fearing that its dislodgment might lead to serious bleeding, this spot was thoroughly coagulated with the spraying current. At this stage the operation was concluded and closure begun. The long operation was exceedingly well borne with practically no change in pulse or blood-pressure from beginning to end.

Postoperative course. The threat of hyperthermia, namely a prompt rise in temperature to 104°, was overcome. Lumbar punctures were made on the second day when 30 cubic centimeters and on the third day when 50 cubic centimeters of blood-stained fluid were withdrawn. Nasal feeding was instituted during the first week owing to deglutitory difficulties. The choked discs subsided fortunately with retention of useful vision. The wound was well healed without tension and the boy was discharged in excellent condition on the twenty-eighth day after operation (Fig. 56). On last reports, he is at school and symptom-free.

The tumor was an astrocytoma of predominantly fibrillary type.

In the next case operated upon by Dr. Horrax a hemi-cystic lesion very similar to that in Case 72 (cf. Fig. 50) was encountered and its solid portion was removed.

CASE 75. A six-year-old child, referred to the hospital by Dr. Charles A. Sparrow of Worcester, Massachusetts, had been considered delicate since the age of four following an attack of whooping cough. She had had occasional attacks of vomiting and had complained of stiffness of the neck. No alarming symptoms however had occurred until six weeks before admission when impairment of sight was observed and for one week she had been blind.

Examination showed the familiar signs of hydrocephalus, a marked secondary optic atrophy without measurable choking, amaurosis and incoordination of ocular movements, a stiff neck with suboccipital tenderness, and a moderate degree of ataxia of all extremities with sluggish deep reflexes.

The operation. Owing to lack of co-operation, the five and a half hour procedure was conducted under avertin-ether anæsthesia. The suboccipital bone was thin and easily removed. An early puncture of the ventricle disclosed a high degree of hydrocephalus under marked tension. The exposed cerebellar hemispheres (Fig. 57) had the typical appearance of a median bulging cyst which was electrically opened by a vertical incision. To the left of the cystic cavity was a sausage-shaped mural tumor, the better to expose which a transverse incision was made over the left hemisphere. The cross cut opened another superficial cyst to the left of the lesion. The growth was easily freed by electrical dissection and removed intact without opening into the fourth ventricle. The vessels at its anterior pole could be seen and clipped before the growth was detached from this critical point. The cavity was filled, as customary, with salt solution and the wound closed.

The tumor (Fig. 58) proved to be a densely fibrillary astrocytoma of the type shown in Figure 37.

Postoperative course. The usual early postoperative rise in temperature (103° F) occurred, and, in spite of a succession of five lumbar punctures, the temperature did not fall to normal till the tenth day. Apart from the blindness the child (Fig. 59) was in excellent condition and essentially free from ataxia at the time of discharge.

The last case included in the Table was an older patient who had a predominantly cystic and well lateralized lesion which at the time of operation was mistaken for a probable angioblastoma.

CASE 76. A farmer aged 21 was referred by Dr. S. C. Cates of East Vassalboro, Maine, owing to rapidly failing vision. The patient obscurely dated his symptoms from a supposed sunstroke two years previously since when he had been subject to "giddy spells." Six months later his sight began to be affected and he became aware of stiffness of the neck and unsteadiness of gait. He insisted that he had never had headache or vomiting and that there had been no change to speak of in his symptoms for a year.

Examination showed moderate hydrocephalus (on X-ray films), extreme suboccipital tenderness, a bilateral secondary (?) optic atrophy with pallor of the discs but no œdema, vision being reduced to counting fingers. There was marked nystagmus, and extreme cerebellar incoordination pointing to a lesion of the right cerebellar hemisphere. An indefinite caloric response to irrigation in the right ear and an apparent erosion of the mesial end of the right petrous ridge shown on the X-ray suggested a possible acoustic tumor.

The operation. Difficulties were encountered from the outset due to huge emissary venous channels in

the bone and scalp necessitating early puncture of the lateral ventricle (Fig. 60). The suboccipital bone was thin and papery well down to the foramen magnum. On opening the dura an extreme pressure cone chiefly of the right tonsil was brought to view. After laminectomizing the atlas, the dural incision was carried down to the axis before the herniated tonsil whose tip was cystic could be liberated. The right hemisphere palpably contained a huge cyst and in the lower part of the field was a dark coloured, superficially placed, reddish tumor nodule so near the surface as almost to suggest an extracerebellar lesion. An electrical incision was made from the distended tonsil upward and across the widened convolutions of the right hemisphere exposing the wall of a huge cyst containing promptly-clotting canary-coloured fluid. The cyst extended across the midline into the left hemisphere and at its base the bulging membrane constituting the roof of the fourth ventricle could be seen. The superficial tumor nodule which was slightly adherent to the dura was electrically excised. It proved to be a highly vascular fibrillary astrocytoma.

Postoperative course. From this simple operation, as might be expected, the patient made a prompt and satisfactory recovery (Fig. 61) with rapid subsidence of his cerebellar symptomatology and, curiously enough, with definite improvement in vision.

Thus, of these last six cases which represent some of the surgical problems likely to be encountered when the effort is made to eradicate the tumor at the primary operation, three have been essentially solid lesions; two have been associated with external cysts of about half the size of the lesion; and the last was a predominantly cystic astrocytoma which had become projected into a lateral hemisphere.

12. SUMMARY

The cerebellar astrocytomata furnish another example of gliomatous tumors which, like the medulloblastomas, show predilection for a favourite site and produce a recognizable syndrome. The tumors are probably of congenital origin and usually date symptomatically from childhood, the average age on admission being 13 years. They are signalized by periodic matutinal headache and vomiting.

Owing to their mid-cerebellar situation, the tumors inevitably cause secondary hydrocephalus and this, in turn, leads to a choked disc which may be so insidious in origin that seriously impaired vision may be the first recorded symptom. They may attain a surprisingly large size before any cerebellar signs, usually shown as instability, put in an appearance.

The tumors may be either compact growths or be largely cystic. When predominantly cystic, recurrence of symptoms is inevitable unless the mural nodule of tumor is identified and removed at the time of operation. To establish this apparently simple fact has required years of observation of cystic lesions variously treated.

The clinical diagnosis lies between astrocytoma and other forms of tumor that frequent the same region, medulloblastoma, angioblastoma and ependymoma, of which the astrocytomata are the most numerous.

The growth is composed of fibrillary and protoplasmic astrocytes in varying proportions and is therefore a mixed tumor, being firm or soft in texture in accordance with the predominating type of cell. An immediate diagnosis of the cytological characteristics of the lesion can be determined in case of doubt by employing the supravital technique.

The tumors may lie exposed on the surface or be wholly concealed; and when so concealed, a vertical incision through the vermis is the proper method of bringing them to view. The operation which can usually be carried out under local anæsthesia should, if possible, be completed at the first session, a complete eradication of the growth at a second session being far more hazardous.

The 18 per cent case mortality for the series of 76 cases is largely ascribable to inexperience and to fatalities from secondary operations. With better understanding of the nature and favoured site of the lesions in the last 25 consecutive operations there has been a case mortality of only 4 per cent in spite of the prolonged and radical operations now undertaken by modern methods with attempted cure at a single session.

BIBLIOGRAPHY

1. Councilman, W. T. Anatomical consideration of tumors of the brain with special reference to the gliomata. Colorado Med., 1915, xii, 289–301.
2. Cushing, H. Experiences with the cerebellar medulloblastomas. A critical review. Acta path. et microb. Scand., 1930, vii, 1–86.
3. Cushing, H., and Bailey, P. Tumors Arising from the Blood-Vessels of the Brain. Angiomatous Malformations and Hemangioblastomas. Springfield, Illinois: Charles C. Thomas, 1928, 219 pp.

4. MARTIN, P. Le traitement chirurgical des gliomes cavitaires de l'encéphale. Arch. franco-belges de chir., 1923, xxvi, 807–847.
5. VAN DESSEL, A. L'incidence et le processus de calcification dans les gliomes du cerveau. Arch. franco-belges de chir., 1925, xxviii, 845–874.
6. CUSHING, H. The intracranial tumors of pre-adolescence. Am. J. Dis. Child., 1927, xxxiii, 551–584.
7. BAILEY, P., and CUSHING, H. A Classification of the Tumors of the Glioma Group on a Histogenetic Basis with a Correlated Study of Prognosis. Philadelphia: J. B. Lippincott Co., 1926, 175 pp.
8. LINDAU, A. Kleinhirncysten: Bau, Pathogenese und Beziehungen zur Angiomatosis retinae. Acta path. et microb. Scand., Suppl. i, 1926, 128 pp.
9. BAILEY, P. Tumors arising from ependymal cells. Arch. Neurol. & Psychiat., 1924, xi, 1–27; Quelques nouvelles observations de tumeurs épendymaires. Ann. d. anat. path. med.-chir., 1925, x, 481–512.
10. EISENHARDT, L., and CUSHING, H. Diagnosis of intracranial tumors by supravital technique. Am. J. Path., 1930, vi, 541–552.
11. KREDEL, F. E. Tissue culture of intracranial tumors. Am. J. Path., 1928, iv, 337–340; Arch. Surg., 1929, xviii, 2008–2018.
12. BAILEY, P. Histologic atlas of gliomas. Arch. Path. & Lab. Med., 1927, iv, 871–921.
13. BAILEY, P., SOSMAN, M. C., and VAN DESSEL, A. Roentgen therapy of gliomas of the brain. Am. J. Roentgenol., 1928, xix, 203–264.
14. CUSHING, H. Technical methods of performing certain cranial operations. Surg., Gynec. & Obst., 1908, vi, 227–246.
15. Idem. The Pituitary Body and its Disorders. Philadelphia: J. B. Lippincott Co., 1912, 341 pp.
16. Idem. Notes on a series of intracranial tumors and conditions simulating them. Arch. Neurol. and Psychiat., 1923, x, 605–668.
17. Idem. Electro-surgery as an aid to the removal of intracranial tumors. Surg., Gynec. & Obst., 1928, xlvii, 751–784.
18. CAIRNS, H. W. B. A study of intracranial surgery. Med. Research Council, Special Report Series, No. 125. London, 1929, 83 pp.

NOTE.—There is appended the table of cases on which this study has been based.

TABLE OF CASES

Serial No.	Hospital No., name and date	Sex, age	Duration (months)	Inaugural symptoms, stage	Operative procedures	Contemporary pathological diagnoses: Pre-operative	Operative	Histological	Convalescent notes Result to last report	Survival period from first operation	Previous references and comments
					JOHNS HOPKINS HOSPITAL SERIES						
1	22013 *Shurley* Feb. 24, 1908	F 23 mos.	12	Advancing hydrocephalus	I. Feb. 29, 1908. Combined lumbar and ventricular puncture II. Mar. 11, 1908. Combined lumbar and ventricular puncture	Hydrocephalus	Hydrocephalus		Some improvement for 6 months		Reported: C. (15-1912, p. 206)
	Readmission Apr. 19, 1909		7	Progressive choked disc, and spasticity	III. Apr. 29, 1909. Suboccipital exploration. Evacuation of huge median cyst largely occupying right hemisphere. Partial removal of cyst wall	Cerebellar tumor (?)	Cerebellar cyst	Autopsy (Figs. 2, 3). Gliomatous cyst (1909). Astrocytoma: protoplasmic (1923); sparsely fibrillary (1930)	Fatality: sudden respiratory failure. Autopsy: Large cyst with flat mural tumor	Postoperative fatality (3 hours)	Cited as protoplasmic astrocytoma with photo: B.&C. (7-1926, p. 149).
2	23809 *Pickett* Apr. 1, 1909	M 26 yrs.	4 yrs.	Unsteadiness. Advanced to impaired vision with periodic amblyopia	I. Feb. 1, 1909. Osteoplastic exploration of left cerebral hemisphere without decompression, performed in Brooklyn, N. Y.	?	?				Reported: M. (4-1923, Case 1). Cf. B. & C. (7-1926, p. 154).
					II. Apr. 14, 1909. Ether. Bilateral cerebellar exploration. Large mesiolateral cyst dissected out together with mural nodule	Cerebellopontile tumor (?)	Cystic glioma with gritty calcification	Gliopsammoma (Mallory: 1909). Astrocytoma fibrillare (1926); moderately fibrillary with calcification (1930)	Perfect recovery apart from impaired vision. Supports family as broommaker (Aug. 28, 1930)	Living 21 years	Mural nodule removed (first case).
3	25961 *Kingsley* May 21, 1910	F 6 yrs.	12	Headaches. Advanced to near blindness	I. May 21, 1910. Customary cerebellar exploration under ether. Puncture lateral ventricle in course. Evacuation deep median cerebellar cyst	Cerebellar tumor	Cerebellar cyst (gliomatous)	No tissues: xanthochromic fluid	Freedom from symptoms apart from loss of vision for 12 months		Cf. B. & C. (7-1926, p. 156).
	Admission to Boston Hosp. Aug. (?) 1911			Return of symptoms	II. Aug. 3, 1911. Reoperation for recurrence of symptoms (Dr. E. H. Nichols, Boston). Partial removal large gliomatous tumor	?	?	?	Freedom from symptoms apart from sight for 20 months		
	Admission to Brigham Hosp. Dec. 8, 1913		8	Return of symptoms	III. Dec. 13, 1913. Extirpation huge recurrent gliomatous mass filling cyst. Exposure of fourth venticle	Recurrent glioma	Recurrent glioma	Glioma with abundant fibril formation (Councilman). Astrocytoma fibrillare (1926); moderately fibrillary (1930)	Fatality from wound infection and streptococcus meningitis 5th day	Survived 3 years to postoperative fatality	
4	26829 *Cumming* Oct. 31, 1910	M. 9 yrs.	5 yrs.	Unsteadiness. Advanced to blindness	I. Nov. 5, 1910. Ether. Suboccipital exploration: marked pressure cone. No surface tumor. Punctures negative	Cerebellar tumor			Considerable relief for 14 months apart from loss of sight: up and about		Reported with photo. as protoplasmic astrocytoma: B. & C. (7-1926, p. 150).
	Readmission Jan. 8, 1912		2	Recurrence. Headaches and vomiting	II. Jan. 20, 1912. Ether. Re-exploration. Evacuation of large midline cyst. Partial extirpation of cyst wall	Cerebellar tumor	Gliomatous cyst		Temporary freedom from discomfort. Increasing instability after Sept. 1912		
	Admission to Brigham Hosp. Jan. 16, 1914		18	Highly advanced syndrome: bedridden. Cerebellar seizures. Spinal paralysis	III. Jan. 20, 1914. Ether. Re-exploration. Disclosure of large median tumor occupying cerebellum and projecting into spinal canal. Incomplete extirpation of growth	Recurrent gliomatous cyst	Cystic glioma	Glioma: fibrillated with hyaline degeneration (1914). Astrocytoma: protoplasmic (1923); sparsely fibrillary throughout (1930)	Postoperative fatality *circa* 10 hours: respiratory failure. Autopsy: syringomyelia of cord; large residual tumor (cf. Fig. 4)	Survived 3 years to postoperative fatality	

5	28010 *Murphy* Oct. 22, 1911 Admission to Brigham Hosp. Oct. 10, 1924	M. 17 yrs.	14 yrs.	Unsteadiness. Advanced syndrome to respiratory failure Sudden return of symptoms after 13 year interval	I. Small right-sided cerebellar decompression (?) performed in 1906 (Chicago) II. Oct. 23, 1911. Emergency puncture of right cerebellar hemisphere while under artificial respiration. Evacuation of cyst III. Oct. 23, 1924. Usual bilateral exposure of cerebellum. Evacuation of huge cyst (125 c.cm.) with removal of egg-sized mural nodule (Fig. 5)	? Cerebellar cyst (?) Recurrent gliomatous cyst	? Gliomatous cyst right cerebellum Cystic glioma	 Fibrillaryglioma (1924). Astrocytoma fibrillare (1926). Scantily fibrillary (1930)	Relief for 5 years Practical freedom from symptoms for 13 years Perfect recovery. In business. Essentially free from symptoms to date (Sept. 29, 1930)	 Living 19 years	Reported as gliomatous cyst with long survival: M (4-1923, Case 2). Cf. B. & C. (7-1926, p. 156).
6	29740 *Caskey* Apr. 27, 1912	M. 23 yrs.	8 yrs.	Headache and vomiting. Advanced to cerebellar seizures	Operation withheld. Palliative callosal puncture for hydrocephalus, ineffective	Cerebellar tumor	Hydrocephalus from tumor	Autopsy: cystic glioma of fourth ventricle (1912). Astrocytoma fibrillare (1926). Moderately fibrillary throughout (1930). Cf. Fig. 6	Death 8th day without cerebellar operation		Reported with photo.; B. & C. (7-1926, p. 161).
	PETER BENT BRIGHAM HOSPITAL SERIES										
7	56 *Pope* Dec. 13, 1912 Readmission Apr. 7, 1913 Readmission May 10, 1913 May, 1920 Readmission Oct. 4, 1922	F. 4 yrs.	12 1 2 2	Headache, vomiting and instability. Moderate Recurrence Prompt recurrence Recurrence Recurrence	I. Dec. 17, 1912. Ether. Suboccipital exploration. Large cyst evacuated with fragmentary portion mural nodule II. Apr. 7, 1913 Puncture of cyst (50 c.cm.) III. May 12, 1913. Repuncture of cyst (50 c.cm.) IV. May 24, 1913. Re-exploration. Evacuation large multilocular cyst; partial extirpation tumor V. May (?) 1920. Re-exploration (Dr. Elsberg, N. Y.). Evacuation huge multilocular cyst. VI. Oct. 13, 1922. Re-exploration. Radical but incomplete removal largely solid tumor	Cerebellar tumor right hemisphere Gliomatous cyst ? Gliomatous cyst	Cyst with tumor nodule Gliomatous cyst ? Cystic glioma	Glioma with dense whorls of glia fibrils (Councilman) Glioma (ditto) ? Glioma (1922). Astrocytoma fibrillare (1926); scantily fibrillary with protoplasmic areas (1930)	Complete relief for 3 months Complete relief for 7 years Complete relief for 2 years Complete relief for 3 years. Death reported Jan. 2, 1926. Autopsy: Hydrocephalus with recurrent glioma	 Survived 13 years.	
8	151 *Shea* June 2, 1913	F. 9 yrs.	18	Headache. Advanced to blindness	June 5, 1913. Ether. Suboccipital exploration. Evacuation large cyst chiefly of right hemisphere with extirpation presenting mural nodule	Cerebellar tumor	Multicystic glioma	Glioma with abundant fibrils (Councilman: 1913). Astrocytoma fibrillare (1926); moderately fibrillary (1930)	Complete freedom from symptoms except blindness to date (Sept. 27, 1930). Graduate Perkins Inst. for Blind	Living 17¼ years	Reported: C. (6-1927, Case 13). Presenting nodule removed.
9	993 *Wellwood* Mar. 7, 1914	M. 14 yrs.	5	Vomiting and headache	Mar. 14, 1914. Ether. Suboccipital exploration. Incision of left hemisphere disclosing large cystic central tumor. Radical extirpation	Cerebellar tumor	Cyst with gliomatous tumor	Glioma with scanty fibrils (Councilman: 1914). Astrocytoma: protoplasmic (1926); largely protoplasmic with moderately fibrillary patches (1930)	Prompt complete recovery. Now married and in practice of law (Sept. 9, 1930)	Living 16½ years	Reported as protoplasmic astrocytoma: B. & C. (7-1926, p. 150). Presenting nodule removed.
10	1150 *Remmes* Apr. 15, 1914 Readmission Jan. 3, 1916	M. 16 yrs.	4 6	Instability, headache and vomiting. Advanced Recurrence Advanced	I. Apr. 27, 1914. Ether. Suboccipital exploration. Transverse incision right hemisphere. Negative findings II. Jan. 17, 1916. Ether. Re-exploration. Extirpation hen's-egg size tumor overlying huge central cyst	Right cerebellar tumor Right cerebellar tumor	Unverified Glioma with cyst	 Multicystic fibrillary glioma (1916). Astrocytoma fibrillare (1926); moderately fibrillary with calcification (1930)	Subsidence of symptoms for 8 months Perfect recovery. Earning living. Married, and children (Aug. 23, 1930)	 Living 16 years	 Presenting tumor removed.

TABLE OF CASES

PETER BENT BRIGHAM HOSPITAL SERIES—*Continued*

Serial No.	Hospital No., name and date	Sex, age	Duration (months)	Inaugural symptoms, stage	Operative procedures	Contemporary pathological diagnoses: Pre-operative	Operative	Histological	Convalescent notes Result to last report	Survival period from first operation	Previous references and comments
11	1649 *Maloney* Aug. 17, 1914	M. 38 yrs.	2 yrs.	Suboccipital pain on lifting with staggering Advanced with cerebellar seizures	I. Aug. 24, 1914. Subtemporal decompression as palliative measure	Cerebellar tumor (?) of left recess (?)			Amelioration of symptoms		
					II. Sept. 2, 1914. Suboccipital exploration. Hydrocephalus, with bilateral puncture ventricles: negative cerebellar findings	Left cerebellar tumor					
	Readmission Dec. 4, 1914			Exacerbation of symptoms	III. Mar. 6, 1915. Suboccipital re-exploration. Evacuation 100 c.cm. xanthochromic cyst: formalin fixation	Left cerebellar tumor	Glioma-tous cyst	Wall of gliomatous cyst: gliosis (1915). Astrocytoma fibrillare (1926); sparsely fibrillary (1930)	Essential freedom from cerebellar symptoms. Chronic alcoholism. Sudden death Grafton State Hosp. July 29, 1929: cerebral apoplexy (no autopsy)	Survived 15 years	Mural growth inadvertently removed.
12	4014 *Meagher* Dec. 17, 1915	M. 13 yrs.	18	Occipital headaches. Advanced to lost vision	Dec. 23, 1915. Ether. Suboccipital exploration + laminectomy atlas. Large multicystic median tumor. Partial extirpation	Median intracerebellar tumor	Cystic glioma fourth ventricle	Cystic glioma, fibrillary (1915). Astrocytoma fibrillare (1926); densely fibrillary (1930)	Amelioration of symptoms for 6 months		
	Readmission Aug. 28, 1916		2	Recurrence	Operation refused				Died May 22, 1917 (no autopsy)	Survived 17 months.	
13	5524 *Burnett* Oct. 6, 1916	F. 12 yrs.	11	Headache and constipation. Moderate	Oct. 10, 1916. Ether. Suboccipital exploration. Extirpation large partly cystic midcerebellar tumor size hen's egg. Procedure incomplete	Cerebellar tumor	Median glioma fourth ventricle	Glioma (1916). Astrocytoma fibrillare (1926); tissue mislaid (1930)	Fatality: hyperthermia (24 hours). Autopsy	Postoperative fatality.	
14	5112 *Benoit* July 21, 1916	M. 14 yrs.	7	Stiff neck and blurred vision Advanced syndrome: near blindness	I. Aug. 6, 1916. Ether. Usual bilateral exploration. Ventricular puncture. Median cyst opened by incision left hemisphere. Partial excision cyst wall. Formalin fixation	Cerebellar tumor	Median cerebellar cyst	Cyst wall: no tumor	Uncomplicated recovery. Early improvement		
	Readmission Dec. 22, 1919		16	Recurrence. Bedridden. Blind	II. Jan. 3, 1920. Ether. Re-exploration, disclosing large solid tumor mass left hemisphere with 30 c.cm. cyst in right. Tumor removed	Cerebellar cyst: recurrent	Large cystic glioma	Cystic glioma (1920). Astrocytoma: protoplasmic (1926); chiefly protoplasmic with rare fine fibrils (1930)	Stormy convalescence: hyperthermia: lumbar punctures. Ultimate good recovery. Living and well in institution for blind; light perception only (Sept. 9, 1930)	Living 14 years.	
15	6150 *Gilman* Jan. 26, 1917	F. 10 yrs.	12	Headache, vomiting and instability following trauma Advanced to blindness	Feb. 1, 1917. Ether. Suboccipital exploration. Large median cyst with midline mural tumor at base. Partial enucleation through transverse cerebellar incision. Zenker fixation	Cerebellar tumor	Midcerebellar cyst with large mural tumor	Glioma: fibrillary (1917). Astrocytoma fibrillare (1926); moderately and coarsely fibrillary (1930)	Excellent result for 6 years despite blindness and home neglect		Cf. photo: B. & C. (7-1926, p. 165).
	Readmission Aug. 15, 1923		6	Recurrence. Highly advanced: cerebellar seizures	No operation owing to intercurrent measles				Sudden death: respiratory failure Oct. 2, 1923. Autopsy: large solid glioma fourth ventricle	Survived 6½ years	

War interval 1917–1919

16	10813 *Mulry* July 13, 1919	F. 22 yrs.	3 yrs.	Headache and vomiting. Full syndrome advanced to near blindness	July 28, 1919. Ether. Usual suboccipital exploration. Ventricular puncture. Nodule of cystic tumor presenting at calamus. Total extirpation	Cerebellar tumor	Median cystic glioma	Glioma, partly calcified (1919). Astrocytoma: protoplasmic (1923); scantily fibrillary (1930)	Prompt improvement. Retention 20/200 vision. Free from symptoms to date (Sept. 11, 1930). Swimming, dancing, etc. Earning living as clerk	Living 11 years	Mural growth inadvertently removed.
17	11183 *Powers* Sept. 19, 1919	F. 11 yrs.	4	Headache and instability after fall. Advanced to blindness	I. Sept. 26, 1919. Ether. Suboccipital exploration. Evacuation large cyst with tumor cap. Latter partially removed Zenker fixation	Cerebellar tumor	Glomatous cyst right hemisphere	Œdematous and fibrillary glioma (1919). Astrocytoma fibrillare (1926); sparsely fibrillary with extensive protoplasmic areas (1930)	Complete relief from symptoms except for blindness for 7½ years		Presenting tumor cap removed.
	(Cleveland Clinic) May, 1927		2	Recurrence	II. May 26, 1927. Re-exploration (Dr. C. E. Locke, Jr., Cleveland). Evacuation cyst. Removal tumor cap. Zenker fixation	Recurrent cyst	Cyst with mural nodule		Perfect recovery apart from blindness (Aug. 26, 1930)	Living 11 years	
18	11374 *Williamson* Oct. 23, 1919	M. 24 yrs.	5(?)	Tinnitus 1 yr. Headache, vomiting, double vision 4 mos. Moderately advanced	I. Oct. 27, 1919. Ether. Suboccipital exploration. Puncture deep xanthochromic cyst right hemisphere	Right acoustic tumor	Glomatous cyst	Xanthochromic fluid	Complete freedom from symptoms 3 years, 4 months		
	(Barnes Hosp., St. Louis) April, 1923		2	Recurrence	II. April 30, 1923. Re-exploration (Dr. Ernest Sachs, St. Louis). Evacuation multiple cysts (60 c.cm.). Fragment only (?) of large tumor mass removed	Recurrent glomatous cyst	Multicystic glioma	Astrocytoma fibrillare (from tissue sent us 1923); densely fibrillary (1930)	Perfect recovery to Aug. 26, 1930	Living 11 years	Subsequent roentgen therapy.
19	11515 *Foster* Nov. 17, 1919	M. 14 yrs.	2 yrs.	Occipital headaches. Advanced syndrome: blind	Dec. 6, 1919. Ether. Usual suboccipital exploration. Huge central cyst (100 c.cm.) with mural nodule not removed. Membranous roof fourth ventricle at base of cavity intact	Cerebellar tumor	Midcerebellar cyst (glomatous)	Cerebellar cyst wall: no tumor Autopsy: Astrocytoma: protoplasmic (1923); rare fibrils (1930)	Perfect immediate recovery. Sudden fatality 16th day while sitting up. Autopsy: mural nodule	Postoperative fatality	
20	12236 *Huppee* April 12, 1920	M. 16 yrs.	6	Headache and vomiting (Abdominal exploration). Fully advanced syndrome	April 20, 1920. Ether. Usual exploration. Disclosure posterior pole of tumor between tonsils. Removed for examination	Cerebellar tumor	Median cerebellar glioma	Glioma with fibril development (1920). Astrocytoma: protoplasmic (1926; 1930)	Satisfactory recovery but return of symptoms 3½ months and death 5 months. No autopsy	Survived 5 months	First observed calamic nodule. Vermis not split.
21	13275 *McCue* Oct. 3, 1920	M. 13 yrs.	10	Blurring vision. Instability. Moderately advanced	I. Oct. 16, 1920. Ether. Suboccipital exploration. Puncture ventricle: hydrocephalus. Negative cerebellar findings except tonsillar herniation	Right cerebellar cyst	Unverified		Only brief improvement in symptoms		
	Readmission Mar. 22, 1921			Continuance of symptoms, now far advanced	II. Mar. 26, 1921. Ether. Re-exploration. Transverse incision through right hemisphere disclosing large solid tumor. Fragmentary removal.	Cerebellar tumor	Cystic glioma	Glioma (1921). Astrocytoma fibrillare (1926); moderately fibrillary throughout (1930)	Sudden respiratory failure 3 weeks postoperative Autopsy: solid midcerebellar glioma	Survived 6 months to postoperative fatality	

TABLE OF CASES

PETER BENT BRIGHAM HOSPITAL SERIES — *Continued*

Serial No.	Hospital No. name and date	Sex, age	Duration (months)	Inaugural symptoms, stage	Operative procedures	Contemporary pathological diagnoses: Pre-operative	Operative	Histological	Convalescent notes Result to last report	Survival period from first operation	Previous references and comments
22	14204 *Taylor* Mar. 18, 1921	M. 14 yrs.	6	Headache and vomiting (Appendix operation) Mild syndrome	I. Mar. 20, 1921. Ether. Usual procedure. Ventricular puncture. Marked herniation. Puncture of bulging vermis (10 c.cm. cyst)	Cerebellar tumor	Midcerebellar cyst		Perfect operative recovery. Early recurrence of symptoms		Roentgen therapy: B. S. & VD.: (13-1928 Case 30).
	Readmission Nov. 14, 1921		6	Recurrence. Increasing severity	II. Nov. 18, 1921. Ether. Re-exploration. Recurrent solid central tumor. Fairly radical excavation	Recurrent cyst	Midline (cystic ?) glioma	Fibrillary glioma (1921). Astrocytoma: protoplasmic (1923); moderately fibrillary (1930). Cf. Fig. 39	Uneventful recovery. Subsidence of symptoms for 6 years. At work		
	Readmission Oct. 26, 1928		6	Recurrence. Marked loss of vision. Exophthalmos. Trigeminal numbness	III. Nov. 3, 1928. Novocain. Re-exploration + laminectomy of atlas. Attempted total electrosurgical removal huge soft recurrent astrocytoma. Ventricle widely opened. Subtotal extirpation IV. Nov. 28, 1928. Novocain. Reoperation in hope of removing remaining portion of tumor. This found adherent to floor of fourth ventricle (Fig. 33)	Recurrent cerebellar astrocytoma	Huge recurrent tumor		Postoperative hiccoughing; hyperthermia. Lumbar punctures. Wound well healed Hyperthermia. Nasal feedings necessary. Death fifth day. Autopsy. (Cf. Fig. 33)	Survived 7 ½ years to postoperative fatality	
23	14616 *Walsh* May 29, 1921	M. 14 yrs.	14	Vomiting, etc. Full blown symptomatology	June 7, 1921. Ether. Suboccipital exploration. Large centrally placed cyst (90 c.cm. clotting fluid). Mural nodule 2 cm. diameter presenting and removed. Zenker fixation	Left cerebellar cyst	Cystic glioma	Cyst with glioma nodule (1921). Astrocytoma fibrillare (1926); moderately fibrillary with dense areas (1930)	Complete subsidence symptoms. Perfect recovery to date (Aug. 28, 1930)	Living 9¾ years	Presenting mural nodule removed.
24	15195 *Seaman* Sept. 15, 1921	F. 12 yrs.	12	Vomiting spells following trauma. Fully developed syndrome	Sept. 21, 1921. Ether. Suboccipital exploration. Extirpation through lateral incision of partly cystic centrally placed dense glioma easily separable from cerebellum, size hen's egg	Cerebellar tumor: (right ?)	Cystic glioma	Fibrillary glioma (1921); Astrocytoma fibrillare (1926); sparsely fibrillary with protoplasmic areas (1930)	Complete subsidence of all symptoms. Perfect recovery to date (Sept. 8, 1930)	Living 9 years	Roentgen therapy reported as favorable: B. S. & VD. (13-1928, Case 45).
25	15308 *Cook* Oct. 3, 1921	M. 9 yrs.	18	Diplopia with failing vision. Advanced to temporary amaurosis. Mild cerebellar signs	I. Oct. 14, 1921. Ether. Usual suboccipital exploration + laminectomy atlas. Large central surface tumor exposed. Extensive but incomplete removal with spoon	Cerebellar tumor (?)	Solid glioma roof fourth ventricle	Glioma (1921)	Good recovery. Discharged symptom free apart from blindness for 3 years		Roentgen therapy: B. S. & VD. (13-1928, Case 33).
	Readmission Mar. 19, 1925		4	Return of headache and vomiting	II. April 9, 1925. Ether. Re-exploration. Extirpation large median partly cystic firm glioma size tennis ball (32 gms.) laying open fourth ventricle	Recurrent midcerebellar astrocytoma	Large median cystic astrocytoma	Astrocytoma fibrillare (1925); scantily fibrillary with protoplasmic areas (1930)	Postoperative hyperthermia. Stormy convalescence. Ultimate excellent recovery. Blind but free from other symptoms. At Perkins Institute for Blind: good student (Sept. 19, 1930)	Living 9 years	First case in which relation to roof of ventricle appears to have been appreciated. (Cf. Case 19).

26	15378 *Ryan* Oct. 13, 1921	F. 13 yrs.	16+	Headaches and vomiting following trauma Well developed syndrome	I. Oct. 19, 1921. Ether. Suboccipital exploration. Evacuation tumor-lined cyst (25 c.cm.) right hemisphere. Partial removal. Zenker fixation	Right cerebellar tumor	Cystic glioma	Gliomatous cyst (1921)	Complete freedom from symptoms for 1 year		Roentgen therapy supposedly beneficial.
	(Barnes Hosp., St. Louis) Jan. 6, 1923		2	Recurrence	II. Jan. 8, 1923. Re-exploration (Dr. Ernest Sachs, St. Louis). Evacuation 60 c.cm. cyst, with partial removal wall; no tumor seen	Cystic glioma	Gliomatous cyst		Relief for 6 months		
	Sept. 1923			Recurrence	III. Sept. 17, 1923. Puncture (Dr. Sachs) of recurrent cyst (120 c.cm.)	Recurrent cyst	Recurrent cyst		Relief for 2 weeks		
	Oct. 22, 1923			Recurrence Urgent	IV. Oct. 23, 1923. Re-exploration (Dr. Sachs) with removal solid laterally placed mural tumor of hen's egg size	Recurrent cyst	Cystic glioma	Astrocytoma: densely fibrillary (1930 on sections submitted)	Complete subsidence of symptoms. Perfect recovery to date (Sept. 2, 1930)	Living 9 years	
27	15488 *Coffey* Nov. 1, 1921	F. 10 yrs.	12	Morning vomiting. Well developed syndrome	I. Nov. 8, 1921. Ether. Suboccipital exploration. Evacuation deep cerebellar cyst (30 c.cm.). Transverse incision right hemisphere. No tumor nodule noted	Midcerebellar tumor	Midcerebellar cyst		Symptom-free for 6 months only		Roentgen therapy: B. S. & VD. (13-1928, Case 46).
	Readmission Sept. 14, 1922		6	Recurrence	II. Sept. 21, 1922. Ether. Re-exploration (Horrax). Re-evacuation 60 c.cm. cyst	Cerebellar cyst: recurrent	Cerebellar cyst: recurrent		Symptom-free for 6 months only		
	Readmission July 23, 1923		6	Recurrence	III. July 31, 1923. Ether. Re-exploration (Horrax). Re-evacuation cyst (90 c.cm.) overlying fourth ventricle. Formalin fixation. Presenting thick wall of cyst removed	(ditto)	(ditto)	Cyst wall which proves to contain fibrillary glioma (1923). Astrocytoma fibrillare (1926); moderately fibrillary (1930)	Complete subsidence of symptoms. Perfect recovery to date (Aug. 22, 1930)	Living 8¾ years	
28	15499 *Parrot* Nov. 3, 1921	M. 16 yrs.	12	Temporary amblyopia. Instability. Advanced to optic atrophy	I. Nov. 12, 1921. Ether. Usual exploration (Horrax). Ventricular tap. Negative findings except thick-walled arachnoid cistern	Cerebellar tumor	Cisternal arachnoiditis?		Good recovery. Subsidence of choked disc. Persistent instability		Roentgen therapy: B. S. & VD.: (13-1928, Case 41).
	Readmission Nov. 17, 1924			Severe headache. Suboccipital protrusion	II. Nov. 29, 1924. Ether. Re-exploration. Central firm glioma with large cyst in left hemisphere. Partial extirpation. Abandoned owing to vascularity	Recurrent cisternal arachnoiditis?	Cystic glioma: median	Glioma?gliosis? (1924). Astrocytoma: protoplasmic (1925); moderately fibrillary (1930)	Good operative recovery. Much improved		
	Readmission Feb. 12, 1926			Highly advanced syndrome: medullary paralyses					Sudden death day after admission from respiratory failure. Autopsy refused	Survived 4¼ years	
29	15933 *Alexander* Jan. 10, 1922	F. 19 yrs.	4	Headache and morning vomiting. Fully developed syndrome	I. Jan. 21, 1922. Ether. Suboccipital exploration. Marked foraminal herniation. Evacuation of 40 c.cm. cyst. Partial removal deep-seated mural nodule. Zenker fixation	Right cerebellar tumor	Gliomatous cyst	Wall of gliomatous cyst	Complete subsidence of all symptoms for *circa* 4 years		Roentgen treatments: four series: supposedly beneficial.
	Readmission Jan. 10, 1927		12	Recurrent inco-ordination	II. Jan. 24, 1927. Novocain. Suboccipital re-exploration. Huge recurrent cyst *circa* 100 c.cm. Disclosure and removal high subtentorial nodule	Recurrent cyst	Cystic "perithelioma"	Astrocytoma fibrillare (1927); sparsely fibrillary with many vessels (1930)	Temporary residual ataxia right arm. Recently married and a mother. Perfect recovery to date (Sept. 2, 1930)	Living 8¾ years	

TABLE OF CASES

PETER BENT BRIGHAM HOSPITAL SERIES — *Continued*

Serial No.	Hospital No., name and date	Sex, age	Duration (months)	Inaugural symptoms, stage	Operative procedures	Contemporary pathological diagnoses: Pre-operative	Operative	Histological	Convalescent notes Result to last report	Survival period from first operation	Previous references and comments
30	16157 *Bedrosian* Feb. 26, 1922	F. 6 yrs.	8+	Vomiting and headache after trauma Advanced to blindness	Discharged against advice without operation	Supraselar cyst? with hydrocephalus	—	—	Periodic recurrence of symptoms for 6 years		
	Readmission Sept. 19, 1928			Recent acute exacerbation: cerebellar seizures	Sept. 28, 1928. Novocain. Preliminary ventriculography disclosing hydrocephalus. Severe reaction. Emergency suboccipital exploration. Exposure large solid glioma presenting right hemisphere. Underlying cyst over roof fourth ventricle (Cf. Fig. 23)	Cerebellar tumor	Cystic astrocytoma fourth ventricle	Astrocytoma fibrillare (1928); scantily fibrillary with extensive protoplasmic areas (1930)	Subsidence of all symptoms apart from blindness to date (Oct. 1, 1930). Student at Perkins Inst. for Blind	Living 2 years.	
31	16164 *Hogan* Feb. 27, 1922	F. 5 yrs.	5	Headache and vomiting Moderate	Mar. 3, 1922. Ether. Suboccipital exploration + laminectomy arch of atlas. Small cystic glioma overlying fourth ventricle incompletely removed	Cerebellar tumor: median?	Midependymal glioma	Gliomatous cyst wall (1922). Astrocytoma fibrillare (1926); sparsely fibrillary throughout (1930)	Subsidence of symptoms. Had normal adolescence. Remains well and active to date (Sept. 12, 1930)	Living 8½ years	Roentgen therapy: B. S. & VD. (13-1928, Case 47).
32	16242 *Gollub* Mar. 11, 1922	F. 14 yrs.	9	Mental changes Fully developed syndrome to failing vision	I. Mar. 22, 1922. Ether. Suboccipital exploration (Horrax). Multilocular central cyst expanding vermis. Evacuation. Zenker fixation.	Median cerebellar tumor	Midcerebellar gliomatous cyst	Gliomatous cyst? Gliosis?	Complete subsidence of all symptoms for 2 years, 3 months		Roentgen therapy supposedly beneficial.
	Readmission June 29, 1925		7	Recurrence	II. July 10, 1925. Re-exploration. Huge central multicystic tumor radically removed by dissection and suction, opening fourth ventricle	Recurrent cyst	Large midcerebellar cystic glioma fourth ventricle	Astrocytoma fibrillare (1925); moderately fibrillary with compact areas (1930)	Perfect result to date (Aug. 25, 1930). Recently married	Living 8½ years	
33	17143 *O'Brien*	F.	? yrs.	Periods of sick headaches since childhood Choked disc with loss of vision	I. Oct. 19, 1917 Subtemporal decompression (Dr. Dean Lewis, Presbyterian Hosp., Chicago)	Cerebral tumor ?	?	—	Temporary relief from headaches. Frequent punctures: huge subtemporal protrusion		
	Aug. 10, 1922	21 yrs.	7+ yrs.	Full-blown cerebellar syndrome Advanced to blindness	II. Aug. 25, 1922. Ether. Suboccipital exploration + laminectomy arch atlas. Tumor wholly concealed. Incision vermis, exposing large deep rubbery growth. Radical but incomplete extirpation	Cerebellar cyst	Median cystic glioma (ependymoma?)	Glioma with fibrils (1922). Astrocytoma fibrillare (1926); coarsely and densely fibrillary (1930)	Death from pulmonary complications: 5 days Autopsy: Tumor of fourth ventricle incompletely removed	Postoperative fatality.	
34	18833 *Marshall* May 14, 1923	F. 14 yrs.	18+	Unsteadiness and headaches Advanced to impaired vision	I. May 22, 1923. Ether. Suboccipital exploration. Tonsillar herniation. Nodule tumor visible at calamus. Vermis incised. Partial removal central tumor involving floor ventricle II. June 7, 1923. Repair suboccipital wound for pseudo-meningocele	Midcerebellar tumor	Ependymal ? glioma	Glioma with fibrils (1923). Astrocytoma fibrillare (1926); sparsely fibrillary (1930)	Marked subsidence of symptoms for 4 years Recurrence symptoms Sept. 1927. Sudden death in cerebellar seizure Oct. 4, 1927. Autopsy	Survived 4½ years	Roentgen therapy. Reported C. (16-1923, Case 29).
35	19130 *Bloom* June 28, 1923	F. 7 yrs.	4	Vomiting and stiff neck Moderately advanced	July 7, 1923. Ether. Suboccipital exploration. Huge central median cyst presenting (60 c.cm.). Wide opening fourth ventricle. Tumor attached to left ventricular wall	Median cerebellar tumor	Gliomatous cyst fourth ventricle	Astrocytoma fibrillare (1923); moderately fibrillary (1930)	Symptom-free and in perfect health to date (Sept. 15, 1930)	Living 7 years	Roentgen therapy. Reported: C. (6-1927, Case 15). Reported: B. S. & VD. (13-1928, Case 49).

36	19611 *Richmond* Sept. 7, 1923	F. 12 yrs.	12	Frontal headache and vomiting Advanced to near blindness: 20/200	I. Sept. 11, 1923. Ether. Usual bilateral exploration. Ventricular puncture, showing hydrocephalus. Herniation tonsils. No surface tumor. Punctures negative. Bulging vermis incised 1 cm.: no tumor disclosed	Median cerebellar tumor: medulloblastoma?	Cerebellar tumor, unverified. Arachnoiditis (?)	—	Temporary hyperthermia. good recovery. Apart from poor vision well for 2 years		Roentgen therapy: Supposedly beneficial.
	Readmission Mar. 29, 1926		6	Recurrence Advanced: unable to walk alone. Convulsion. Hemihypæsthesia	II. April 1, 1926. Novocain-ether. Reexploration. Disclosure of large central soft glioma. Removal largely by suction. Wide opening fourth ventricle. Radical extirpation	Chronic arachnoiditis	Medulloblastoma? fourth ventricle	Astrocytoma: mainly protoplasmic (1926); moderately fibrillary with protoplasmic areas (1930)	Stormy convalescence. Oculomotor and facial paralyses. Lumbar punctures. Nasal feedings. Final recovery. Living to date (June 5, 1930)	Living 7 years	
37	19941 *Arnsberger* Oct. 21, 1923	F. 17 yrs.	2 yrs. +	Headache, vomiting and staggering gait Advanced to near blindness	Nov. 2, 1923. After preliminary ventriculogram. Ether. Suboccipital exploration (Horrax). Median cyst opened through left hemisphere. Partial (?) removal deep mural nodule. Zenker fixation	Cerebellar tumor	Glomatous cyst	Astrocytoma fibrillare (1923); sparsely fibrillary (1930)	Symptom-free, apart from impaired vision, to last report (Oct. 2, 1930). Married and active as housekeeper	Living 7 years	No roentgen therapy.
38	20153 *Perry* Nov. 19, 1923	M. 8 yrs.	10	Headache, vomiting and staggering Advanced to impaired vision	Preliminary ventriculograms. Nov. 30, 1923. Suboccipital exploration. Incision vermis. Subcortical median tough tumor fourth ventricle. Fragmentary removal	Midcerebellar tumor	Median subcortical solid glioma: no cyst	Fibrillary glioma (1923); Astrocytoma fibrillare (1926); scantily fibrillary throughout (1930)	Symptom-free to date (Aug. 27, 1930). At school	Living 6¾ years	Roentgen therapy: B. S. & VD. (13-1928, Case 50).
39	20509 *Thummel* Jan. 13, 1924	F. 5 yrs.	11	Suboccipital headache and vomiting after whooping cough	Jan. 21, 1924. Ether. Usual bilateral exploration + laminectomy atlas. Evacuation 60 c.cm. cyst. Transverse incision. Extirpation by suction large mural tumor. Zenker fixation	Cerebellar tumor	Protoplasmic? astrocytoma	Astrocytoma fibrillare (1924); sparsely fibrillary throughout (1930)	Convalescence smooth. Symptom-free to date (Aug. 25, 1930). Normal development	Living 6½ years	Roentgen therapy: B. S. & VD. (13-1928, Case 53).
40	22335 *Maffini* Oct. 8, 1924	F. 3 yrs.	4	Squint Advanced to near blindness	I. Oct. 17, 1924. Ether. Usual bilateral exploration. Large multicystic mesial lesion with mural nodule size hen's egg. Incomplete removal, opening fourth ventricle II. Nov. 3, 1924. Re-operation for repair of pseudo-meningocele. Exposure and removal of remaining nodule of tumor. Fourth ventricle widely exposed	Cerebellar tumor	Cystic glioma	Astrocytoma: protoplasmic (1924): sparsely fibrillary with protoplasmic areas (1930). (Cf. Fig. 38)	Excellent recovery. Repair deep sutures necessary Uninterrupted convalescence. Perfect result. Normal health and activity (Sept. 30, 1930). At school for blind	Living 6 years	No roentgen therapy. Reported: C.(6-1927, Case 14).
41	22458 *Osborne* Oct. 24, 1924	M. 3 yrs.	4	Suboccipital headache after whooping cough Advanced to optic atrophy	I. Oct. 27, 1924. Ether. Bilateral cerebellar exploration. Deep midline gliomatous cyst (*circa* 80 c.cm.). Transcortical incision right hemisphere. Fragmentary removal mural tumor. Zenker fixation	Cerebellar tumor	Glomatous cyst	Astrocytoma: protoplasmic	Excellent 3-year recovery, with impaired vision		Roentgen therapy.
	Readmission Nov. 10, 1927		2	Recurrence	II. Dec. 6, 1927. Novocain-rectal ether. Radical electrosurgical piecemeal extirpation (Fig. 31) huge median tumor, with wide exposure fourth ventricle, iter and crura cerebri	Glomatous cyst recurrent	Large central recurrent tumor	Astrocytoma fibrillare (1927); *circa* half protoplasmic, half densely fibrillary (1930). (Cf. Fig. 40)	Postoperative hyperthermia: death 48 hours. Autopsy (Cf. Fig. 32)	Survived 3 years to postop. fatality	

TABLE OF CASES

PETER BENT BRIGHAM HOSPITAL SERIES — *Continued*

Serial No.	Hospital No., name and date	Sex Age	Duration (months)	Inaugural symptoms, stage	Operative procedures	Contemporary pathological diagnoses: Pre-operative	Operative	Histological	Convalescent notes Result to last report	Survival period from first operation	Previous references and comments
42	22975 *Davis* Jan. 9, 1925	M. 20 yrs.	7	Headache and vomiting Early syndrome	I. Jan. 22, 1925. Usual bilateral exploration. Tumor concealed. Incision vermis. Exposure and extensive excavation of tumor over fourth ventricle. Anterior part of ventricle opened	Cerebellar tumor	Ependymoma?	Astrocytoma fibrillare (1925)	Excellent recovery. Returned to work. Gained 50 lb.		Roentgen therapy (6 R).
	Readmission Feb. 3, 1926		6	Recurrence Occasional headache	II. Mar. 2, 1926. Novocain-ether. Re-exploration + laminectomy atlas. Fragmentary removal by suction of tumor, with unblocking of iter.	Recurrent astrocytoma fourth ventricle	Recurrent astrocytoma fourth ventricle	Astrocytoma fibrillare (1926); moderately fibrillary with a few dense patches (1930)	Stormy convalescence. Dysphagia with dysarthria. Nasal feedings, etc. Ultimate fair recovery to date (Sept. 9, 1930)	Living 5¾ years	Roentgen therapy (1 R).
43	24519 *J. Johnston* Aug. 7, 1925	F. 11 yrs.	7 yrs.	Intermittent headache and vomiting Not advanced	I. Aug. 11, 1925. Ether. Usual bilateral exploration + laminectomy atlas. Wholly concealed tumor. Incision vermis. Evacuation large (75 c.cm.) cyst. Mural tumor over ventricle not removed. Formalin fixation	Cerebellar astrocytoma?	Midcerebellar cystic astrocytoma	Gliosis?	Excellent recovery with complete freedom from symptoms (3 years, 9 months)		No roentgen therapy.
	Readmission June 3, 1929		1	Recurrence	II. June 13, 1929. Novocain. Re-exploration. Radical electrosurgical extirpation huge recurrent solid pear-shaped tumor. (Figs. 27-28)	Recurrent cyst	Recurrent (solid) astrocytoma fourth ventricle	Astrocytoma fibrillare (1929); densely fibrillary and œdematous (1930)	Stormy convalescence. Postoperative hyperthermia: 106.2°; diplopia. Ultimate good recovery. Normal health and activity to date (Oct. 10, 1930)	Living 5 years	
44	25318 *Benoit* Dec. 4, 1925	M. 18 yrs.	6	Suboccipital headache. Otitis media Advanced syndrome	Dec. 12, 1925. Ether. Bilateral suboccipital exploration. Marked pressure cone. Partial removal large tumor-lined mesial cyst (60 c.cm.). Formalin fixation. (Cf. Fig. 17)	Cerebellar tumor (abscess?)	Glomatous cyst tumor-lined	Astrocytoma fibrillare: calcified (1925); scantily fibrillary (1930). (Cf. Fig. 46)	Sudden respiratory failure 12 hours postop. Autopsy. (Cf. Fig. 18)	Postoperative fatality.	
45	26049 *Kent* Mar. 27, 1926	M. 6 yrs.	7	Frontal headache and vomiting Advanced to poor vision	Mar. 31, 1926. Ether. Usual exploration (Horrax). Pressure cone. Transection left hemisphere. Large partly cystic central tumor. Radical attack by suction. Ventricle not opened	Midcerebellar tumor	Medulloblastoma?	Astrocytoma: protoplasmic (1926); scantily fibrillary throughout (1930)	Discharged in excellent condition. Perfect health with fair vision to date (Sept. 9, 1930)	Living 4½ years	Roentgen therapy: supposedly beneficial.
46	26178 *Fitzpatrick* Apr. 17, 1926	M. 4 yrs.	12	Unsteadiness, headache and vomiting	April 30, 1926. Ether. Usual exploration + laminectomy atlas. Transverse incision right hemisphere. Huge cystic lesion with large basal mural nodule. Radical attack with wide opening fourth ventricle. Subtotal removal	Median cerebellar tumor (Medulloblastoma?	Cystic astrocytoma with rubbery tumor nodule	Astrocytoma fibrillare (1926); densely and coarsely fibrillary throughout (1930)	Postoperative hyperthermia: 105°. Perfect result. Symptom-free to date (Aug. 23, 1930)	Living 4½ years	Roentgen therapy.
47	26600 *Goldstein* June 21, 1926	F. 7 yrs.	2 yrs.	Intermittent headache and vomiting Advanced: optic atrophy	June 26, 1926. Ether. Bilateral cerebellar exploration. Large cyst (50 c.cm.) overlying median mural nodule size hen's egg. Attempted removal abandoned owing to patient's condition	Midline cerebellar tumor	Fibrillary astrocytoma	Astrocytoma fibrillare (1926); loose meshwork: finely fibrillary throughout (1930)	Postoperative respiratory failure (3 hours). No autopsy	Postoperative fatality.	
48	27174 *Stafford* Sept. 8, 1926	F. 14 yrs.	19	Headache and vomiting, with remissions Advanced: patient bedridden	Sept. 14, 1926. Ether. Usual bilateral exploration (Horrax). Transverse incision into right hemisphere. Extirpation large firm mural nodule extending beyond midline. Ventricle not opened	Right cerebellar tumor	Cystic glioma with firm mural nodule	Astrocytoma fibrillare (1926); densely fibrillary in patches (1930)	Uneventful convalescence. Gradual subsidence of all symptoms. Perfectly well to date (Sept. 5, 1930). In last year at high school	Living 4 years	Roentgen therapy.

49	27295 *Leonard* Sept. 27, 1926 Readmission Apr. 14, 1927	F. 8 yrs.	3+	Headache and vomiting Early syndrome Slight return instability	I. Sept. 30, 1926. Novocain-ether. Usual procedure + laminectomy atlas. Marked pressure cone. Fragmentary removal for diagnosis of large central vascular growth (Fig. 41A) II. April 21, 1927. Ether. Re-exploration. Total electrosurgical removal growth, widely exposing fourth ventricle (Fig. 41B)	Midcerebellar medulloblastoma? Midcerebellar angioblastoma	Angioblastoma Astrocytoma fourth ventricle (Fig. 42)	Insufficient tissue for diagnosis Astrocytoma: protoplasmic (1927); almost wholly protoplasmic: rare fibrils (1930). (Cf. Fig. 44)	Prompt recovery: great symptomatic improvement Critical convalescence. Postoperative hyperthermia. Ventricular and lumbar taps. Perfect recovery to date (Sept. 10, 1930)	 Living 4 years	Roentgen therapy. Reported: C. (6-1927, Case 7). C. (17-1928, Case 10); C. (18-1929, Case 28). First operation in series in which electrosurgical measures employed.
50	28136 *Rosenberg* Feb. 2, 1927	F. 14 yrs.	5	Headache and vomiting. Mild cerebellar symptomatology Early secondary atrophy	Feb. 19, 1927. Ether. Usual approach. Concealed tumor. Incision of vermis exposing large soft growth. Radical removal by suction, widely opening fourth ventricle	Cerebellar lesion: arachnoiditis?	Medulloblastoma?	Astrocytoma fibrillare (1927); finely fibrillary throughout (1930)	Excellent recovery, though slight postoperative hyperthermia. Normal health to date (Aug. 25, 1930)	Living 3½ years	Single X-ray treatment. Reported: C. (18-1929, Case 23).
51	28974 *MacMellon* June 10, 1927 Readmission July 17, 1928	F. 5 yrs.	18 2	Tilting of head Advanced cerebellar syndrome Recurrence. Optic atrophy	I. June 21, 1927. Ether. Usual procedure (Horrax). Disclosure large median partly cystic firm tumor. Incision left hemisphere. Fragmentary removal by suction II. Aug. 6, 1928. Novocain. Re-operation. Total electrosurgical extirpation vascular solid (85 gm.) median tumor, lying chiefly to left. Wide exposure fourth ventricle and tentorium	Midline cerebellar tumor Recurrent astrocytoma	Cystic astrocytoma Recurrent astrocytoma	Astrocytoma fibrillare (1927); densely fibrillary (1930) Astrocytoma fibrillare (1928); densely fibrillary with protoplasmic areas and calcification (1930)	Uncomplicated convalescence: persistent tilting of head. Marked improvement 10 mos. Stormy postoperative course. Fatality 4th day. Autopsy: Postoperative clot occluding iter	 Fourteen months to postop. fatality.	
52	29741 *Gray* Sept. 27, 1927	M. 12 yrs.	12	Following trauma. Headache from early life Advanced: cerebellar convulsions; impaired vision	Oct. 1, 1927. Ether. Usual bilateral exploration + laminectomy atlas. Wholly concealed tumor. Incision vermis disclosing deep cyst (40 c.cm.) overlying tough mural nodule size hen's egg. Radical removal by electrosurgery. Wide opening fourth ventricle	Right cerebellar astrocytoma	Astrocytoma of fourth ventricle	Astrocytoma fibrillare (1927); densely and coarsely fibrillary (1930)	Perfect recovery. At school. Normal health and activity to last report (Oct. 4, 1930)	Living 3 years	Supravital method of diagnosis introduced.
53	30113 *Morrow* Nov. 16, 1927	M. 34 yrs.	5 yrs.	Dizziness. Pain in back of neck Advanced cerebellar syndrome	Nov. 29, 1927. Novocain-ether. Bilateral suboccipital exploration + laminectomy atlas and axis. Huge midline glioma from floor fourth ventricle projecting into spinal canal. Extensive removal by electrosurgery with wide exposure ventricle and iter. (Cf. Fig. 16)	Cerebellar tumor (right)	Ependymoma? with spinal extension	Astrocytoma fibrillare (1927); densely and coarsely fibrillary throughout (1930)	Postoperative abdominal symptoms. Death 4 days. Autopsy: Acute duodenal perforation with general peritonitis	Postoperative fatality.	
54	30443 *Bifulco* Jan. 11, 1928	M. 7 yrs.	24	Vomiting Advanced to impaired vision to atrophy	I. Jan. 18, 1928. Novocain-ether. Usual bilateral exploration. Median incision vermis, exposing deep cystic tumor (50 c.cm.) with large mural nodule. Partial removal by electrosurgery and suction (Fig. 20) II. Feb. 10, 1928. Re-operation for repair of spurious meningocele. Exposure of old field. Attempted removal remaining tumor fragment opening ventricle	Cystic astrocytoma —	Cystic astrocytoma with high mural nodule —	Astrocytoma fibrillare (1928); densely fibrillary (1930) —	Smooth convalescence with excellent recovery: walking. Postoperative hyperthermia with fatality (36 hours) from fulminating meningitis	 Postoperative fatality.	
55	30509 *Harvey* Jan. 19, 1928	M. 18 yrs.	16	Vomiting. Recurrent attacks Advanced: Bedridden; high choked disc	Jan. 30, 1928. Novocain. Bilateral suboccipital exploration. Median incision vermis opening huge cyst (75 c.cm.) with deep mural nodule. Total electrosurgical removal, with partial opening of fourth ventricle (Cf. Fig. 19)	Fourth ventricle tumor	Cystic astrocytoma with mural nodule	Astrocytoma fibrillare (1928); densely fibrillary and vascular with calcification (1930)	Smooth convalescence. Perfect recovery: no residual symptoms. At work to date (Aug. 25, 1930)	Living 2⅔ years	Cf. sketch: C. (17-1928, p. 28).

TABLE OF CASES

PETER BENT BRIGHAM HOSPITAL SERIES — *Continued*

Serial No.	Hospital No., name and date	Sex Age	Duration (months)	Inaugural symptoms, stage	Operative procedures	Contemporary pathological diagnoses: Pre-operative	Operative	Histological	Convalescent notes Result to last report	Survival period from first operation	Previous references and comments
56	31096 *Coffy* Apr. 5, 1928	F. 4 yrs.	7+	Suboccipital headache after whooping cough Syndrome fully developed	Apr. 11, 1928. Novocain. Usual suboccipital exploration with evacuation 60 c.cm. cyst right hemisphere and electrosurgical extirpation large mural nodule	Median cerebellar tumor: medulloblastoma?	Cystic fibrillary astrocytoma	Astrocytoma fibrillare (1928); half protoplasmic, half moderately fibrillary (1930)	Symptom-free to date (June 14, 1930). Perfect result	Living 2½ years.	
57	31353 *Ouellette* May 11, 1928	M. 27 yrs.	24+	Intermittent headache and vomiting Advanced to blindness Diagnosis obscure	May 17, 1928. Preliminary ventriculography. May 18. Emergency operation. Novocain. Usual procedure. Vertical incision bulging vermis. Large median cyst (40 c.cm.). Small lateral nodule removed by electrosurgery. Zenker fixation. Thin roof fourth ventricle intact	Posterior fossa lesion? Preliminary ventriculogram: cerebellar tumor	Median gliomatous cyst with nodule (Cf. Fig. 10)	Astrocytoma fibrillare (1928); densely fibrillary (1930)	Perfect recovery. Symptom-free, except for loss of vision, to last report (July 7, 1930)	Living 2⅓ years.	
58	31798 *Thompson* July 12, 1928	M. 17 yrs.	(13 yrs. ?) 12	Vomiting attacks age 4 to 6 Recurrence with advanced symptomatology	July 26, 1928. Novocain. Usual operation. Tumor not exposed. Vertical incision vermis. Extensive removal huge tough midline tumor by electrosurgery and suction. Residual shell of tumor over fourth ventricle	Cerebellar tumor	Median solid astrocytoma fourth ventricle	Astrocytoma fibrillare (1928); largely protoplasmic, with short sparse fibrils (1930)	Perfect result. Symptom-free to date (Aug. 31, 1930)	Living 2 years.	
59	32724 *Golder* Nov. 23, 1928	F. 6 yrs.	18 4	Weakness right side Recurrence of headache and vomiting Bulging decompression Nuclear paralyses	I. Children's Hospital, Boston. April 13, 1928. Unilateral cerebellar exploration (Horrax). Disclosure of supposedly inoperable tumor of pons (?) II. Dec. 12, 1928. Novocain-ether. Usual bilateral procedure + laminectomy atlas. Incision of vermis. Extensive though incomplete removal large median multicystic tumor (*circa* 60 c.cm.), opening fourth ventricle (Cf. Fig. 21)	Tumor of pons? Tumor of right cerebellopontile angle	Inoperable tumor of pons Midline cystic astrocytoma fourth ventricle	— Astrocytoma fibrillare (1928); coarsely fibrillary (1930)	Postoperative X-ray treatment with temporary improvement for 3 months Complete freedom from symptoms. Well and active to date (Aug. 23, 1930)	 Living 1⅗ years	Roentgen therapy.
60	32785 *Lederman* Dec. 3, 1928	M. 16 yrs.	7 yrs.?	Headache and diplopia Advanced to near blindness and cerebellar seizures	Dec. 5, 1928. Ether. Usual exploration + laminectomy atlas. Median incision vermis disclosing large solid tumor. Radical removal by electrosurgery and suction, with full exposure fourth ventricle and iter	Right cerebellar tumor	Median astrocytoma fourth ventricle	Astrocytoma fibrillare (1928); moderately fibrillary with protoplasmic areas and calcification (1930)	Excellent general condition to date (Aug. 23, 1930). Impaired vision only residual	Living 1⅗ years.	
61	32966 *Matthews* Dec. 31, 1928	M. 22 mos.	6	Unsteadiness of gait only Early symptom with hydrocephalus	Jan. 8, 1929. Novocain-ether. Usual procedure. Huge central cyst (90 c.cm.) with flat mural tumor over roof fourth ventricle. Extirpation of cyst wall with removal specimen of growth	Midline cerebellar tumor (medulloblastoma?)	Cystic astrocytoma fourth ventricle (Cf. Fig. 8)	Astrocytoma fibrillare (1929); sparsely fibrillary (1930)	Perfect recovery to date (June 15, 1930). Runs and plays normally	Living 1½ years.	
62	33089 *Ehrlich* Jan. 20, 1929	F. 16 yrs.	4 yrs. +	Unsteadiness Fully developed syndrome with convulsions	Jan. 23, 1929. Novocain. Usual procedure. Incision of vermis. Evacuation of midline cyst (35 c.cm.) disclosing large mural tumor of left hemisphere. Complete removal by electrosurgery (Cf. Fig. 24)	Midline cerebellar tumor	Cystic astrocytoma with mural tumor left hemisphere	Astrocytoma fibrillare (1929); chiefly protoplasmic, partly finely fibrillary (1930)	Perfect recovery to date: at college (Oct. 6, 1930)	Living 1¾ years.	

63	33262 *Smith* Feb. 11, 1929	M. 24 yrs.	9	Headache and diplopia Advanced syndrome	Feb. 16, 1929. Novocain. Usual procedure. Incision of vermis, exposing median cyst with deep mural nodule. Partial removal by electrosurgery. Fourth ventricle widely opened	Cerebellar tumor	Cystic astrocytoma with mural nodule	Astrocytoma fibrillare (1929); sparsely fibrillary with markedly vascular areas (1930)	Perfect recovery to last report (Oct. 27, 1930). Free from symptoms: working steadily	Living 1⅗ years+.	
64	33686 *Cohen* Apr. 6, 1929	M. 4 yrs.	4	Headache and vomiting Moderate	April 18, 1929. Ether. Usual exploration + laminectomy atlas. Vertical incision of vermis. Deep median cystic tumor (30 c.cm.) removed by electrosurgery and suction. Floor of fourth ventricle laid bare (Cf. Fig. 12)	Fourth ventricle tumor (medulloblastoma?)	Median cystic astrocytoma fourth ventricle	Astrocytoma fibrillare (1929); largely protoplasmic with sparse fibrils throughout (1930)	Stormy convalescence with hyperthermia. Unconscious for 2 weeks. Slow remarkable recovery. Discharged June 8, 1929. Present normal health and activity (Sept. 6, 1930)	Living 1⅕ years.	
65	33768 *Howe* Apr. 18, 1929	F. 14 yrs.	24	Unsteady gait Advanced to impaired vision	April 22, 1929. Novocain. Usual procedure. Tumor wholly concealed. Median incision of vermis. Radical extirpation by electrosurgery and suction of solid median tumor. Wide exposure fourth ventricle	Median cerebellar tumor with bruit (angioblastoma?)	Median fibrillary astrocytoma fourth ventricle	Astrocytoma fibrillare (1929); protoplasmic with moderately fibrillary areas (1930)	Perfect operative recovery. Free from symptoms to date (July 5, 1930). At school	Living 1⅓ years.	
66	34311 *P. Johnson* June 28, 1929	F. 15 yrs.	12	Headaches and vomiting Advanced to near blindness	July 3, 1929. Novocain. Usual procedure. Puncture 60 c.cm. cyst left hemisphere. Disclosure and total electrosurgical extirpation large mural nodule under tentorium. Thin roof fourth ventricle intact (Cf. Fig. 22)	Left cerebellar tumor	Cystic astrocytoma chiefly left hemisphere	Astrocytoma fibrillare (1929); moderately fibrillary (1930)	Perfect operative result. Complete freedom from symptoms to date (June 7, 1930), apart from impaired vision 20/50	Living 1¼ years.	
67	34395 *Esposito* July 12, 1929	M. 41 yrs.	12	Occipital headaches, vomiting and dizziness Advanced to near blindness. Bedridden	July 16, 1929. Novocain. Usual procedure. Tumor presenting at calamus. Incision vermis. Radical but incomplete electrosurgical extirpation partly cystic tumor, with wide exposure fourth ventricle	Median cerebellar tumor	Median cystic astrocytoma fourth ventricle	Astrocytoma fibrillare (1929); scantily and finely fibrillary with highly vascular areas (1930)	Perfect operative result. Apart from impaired vision 20/60, free from symptoms to date (Sept. 26, 1930)	Living 1 year.	
68	35405 *Perron* Dec. 7, 1929	F. 8 yrs.	4 yrs.	Periods of headache and vomiting Full-blown symptomatology	Dec. 17, 1929. Novocain-ether. Usual procedure + laminectomy atlas. Exposure large median solid midline tumor. Incomplete electrosurgical excavation. Operation abandoned. Attempted transfusion (Cf. Fig. 14)	Median cerebellar tumor. Astrocytoma?	Median solid astrocytoma of large size	Astrocytoma fibrillare (1929); densely fibrillary with extensive oedematous areas (1930) (Cf. Figs. 34 and 37)	Postoperative respiratory failure (2 hours). Autopsy. (Cf. Fig. 15)	Postoperative fatality.	
69	35556 *McKay* Jan. 2, 1930	F. 12 yrs.	2 yrs.	Impairment of vision first recorded symptom Moderately advanced	Jan. 13, 1930. Novocain. Usual exploration. Incision vermis, disclosing deep median wholly concealed solid tumor of roof fourth ventricle. Electrosurgical extirpation after scalloping, with wide exposure ventricle. (Cf. Fig. 11)	Right cerebellopontile? tumor	Median non-cystic astrocytoma	Astrocytoma: densely fibrillary throughout (1930)	Stormy convalescence. Postoperative right facial paralysis. Excellent ultimate recovery. Active and in good health. Residual facial palsy. Vision greatly improved to date (Aug. 24, 1930)	Living 7 months.	
70	35841 *Mangione* Feb. 17, 1930	F. 7 yrs.	12+	Unsteadiness Advanced to near blindness	Mar. 3, 1930. Novocain-ether. Usual procedure + laminectomy atlas. Tumor subcortical. Vertical incision vermis. Electrosurgical excavation of large solid growth left incomplete with residual shell over fourth ventricle (Cf. Fig. 13)	Cerebellar tumor: medulloblastoma or astrocytoma?	Median subcortical solid astrocytoma large size	Astrocytoma: densely fibrillary (1930)	Perfect operative result. Free from symptoms to date apart from lowered vision (Sept. 6, (1930)	Living 6 months.	

TABLE OF CASES

PETER BENT BRIGHAM HOSPITAL SERIES—*Continued*

Serial No.	Hospital No., name and date	Sex Age	Duration (months)	Inaugural symptoms, stage	Operative procedures	Contemporary pathological diagnoses: Pre-operative	Operative	Histological	Convalescent notes Result to last report	Survival period from first operation	Previous references and comments
71	35991 *Niedzialek* Mar. 11, 1930	F. 10 yrs.	12	Headache and vomiting Advanced to complete blindness	Mar. 21, 1930. Novocain. Usual procedure + laminectomy atlas. Median tumor wholly concealed. Vermis split. Total enucleation 51-gram growth with wide exposure fourth ventricle	Median cerebellar fibrillary astrocytoma	Median subcortical cystic astrocytoma fibrillare	Astrocytoma: moderately fibrillary, with oligoglia and calcification (1930)	Perfect operative recovery. Free from symptoms to date apart from blindness (Sept. 1, 1930)	Living 5 months.	
72	36056 *Garro* Mar. 20, 1930	F. 12 yrs.	6 3 yrs. (?)	Faulty position with frontal headaches Advanced to lowered vision 20/70	Mar. 28, 1930. Novocain. Usual exposure + laminectomy atlas. Tumor concealed. Incision vermis. Total extirpation by electrosurgical method of large lateral nodule in 60 c.cm. cyst. Roof fourth ventricle intact	Median cerebellar tumor: medulloblastoma?	Median cystic astrocytoma	Astrocytoma: densely fibrillary (1930) (Cf. Fig. 45)	Perfect operative recovery. Symptom-free by 6 weeks. Normal to date (Oct. 17, 1930)	Living 7 months.	
73	36307 *Drigotas* Apr. 22, 1930	M. 12 yrs.	10	Vomiting and diplopia. Unmistakable syndrome with unimpaired vision 20/50	April 29, 1930. Novocain. Usual exposure. Tumor concealed. Incision vermis. Total extirpation by electrosurgical methods of large median astrocytoma. Tentorial bleeding. Muscle stamp from leg. Wide opening fourth ventricle. Transfusion	Median cerebellar tumor	Median cystic astrocytoma	Astrocytoma: sparsely fibrillary (1930)	Perfect operative recovery. Practically symptom-free on discharge and at last report (Aug. 24, 1930)	Living 4 months +.	
74	36571 *Zweifel* May 28, 1930	M. 11 yrs.	30	Headache and vomiting Advanced to impaired vision	June 14, 1930. Novocain. Usual exposure. Tumor concealed. Incision vermis. Large astrocytoma with cystic center (30 c.cm.). Piecemeal extirpation, subtotal owing to bleeding from anterior pole	Midline cerebellar astrocytoma	Midline solid astrocytoma fibrillare	Astrocytoma: densely fibrillary with whorls (1930)	Stormy convalescence from operation. Rapid subsidence all symptoms. Discharged July 12, 1930. Well and at school at last report (Oct. 10, 1930). Vision preserved	Living (recent).	
75	36984 *Lemoine* July 28, 1930	F. 6 yrs.	18	Stiff neck and vomiting Advanced to complete blindness	Aug. 1, 1930. Novocain-ether. Usual exploration. Bulging median cyst with large lateral tough mural nodule size hen's egg. Electrosurgical total extirpation: ventricle not opened (Horrax)	Median cerebellar tumor: astrocytoma?	Median cystic astrocytoma with large mural tumor	Astrocytoma: densely fibrillary (1930)	Prompt uncomplicated recovery. Discharged Aug. 21, 1930, practically symptom-free apart from blindness	Living (recent).	
76	37105 *Quinnam* Aug. 15, 1930	M. 21 yrs.	2 yrs. +	Suboccipital headaches Advanced to near blindness	Aug. 18, 1930. Novocain. Usual exploration + laminectomy atlas, excessively bloody. Extreme pressure cone. Largely right-sided cyst involving tonsil. Evacuation 60 c.cm. fluid and total extirpation laterally placed small mural nodule	Right cerebellar tumor: astrocytoma?	Cystic astrocytoma or angioblastoma	Astrocytoma: coarsely fibrillary and œdematous with marked vascularity (1930)	Excellent uncomplicated recovery. Subjective improvement in vision. Discharged Sept. 6, 1930	Living (recent).	

THE ETIOLOGICAL RÔLE OF GAS-FORMING BACILLI IN EXPERIMENTAL BILE PERITONITIS[1]

ALLAN G. REWBRIDGE, M.D., CHICAGO
From the Department of Surgery of the University of Chicago

THERE is a difference of opinion about the action of sterile bile on the peritoneum. Many surgeons believe that its deleterious action depends on the presence of bacteria rather than on the bile itself. Investigators, however, have shown that when sufficient amounts of bile are placed in the peritoneal cavity a fatal peritonitis is produced. Our purpose has been to study the sequence of events which follows the placing of sterile bile in the peritoneal cavity.

Clinically, peritonitis resulting from extravasations of bile is not exceedingly rare. Erdmann in 1903, reported 34 instances of spontaneous rupture of the gall bladder during typhoid fever. Twenty-seven were not operated upon and all died. Seven were operated upon and 4 recovered. McWilliams, in 1912, reported 108 cases of spontaneous perforations of infected biliary systems. Even though these cases received surgical treatment the mortality rate was 48 per cent.

The significance of the escape of sterile bile into the peritoneal cavity is not generally agreed upon. Courvoisier, in 1890, collected 34 instances of rupture of the biliary passages following trauma, of which 22 died and 12 recovered. In no instance did a patient recover without operation or puncture. Only 5 of these patients died within 24 hours and the sixth died within 48 hours. Hæmorrhage from the liver was observed at necropsy in 3.

In 1905 Ricketts combined in a report 273 instances of spontaneous perforations and traumatic ruptures of the gall bladder and noted a better prognosis in the latter group. Two hundred twenty-four cases of spontaneous rupture of the gall bladder were reported; 64 were operated upon, of which 43 recovered and 21 died; 160 were not operated upon, of which 6 recovered and 154 died. In this series of 224 cases 67.2 per cent recovered following surgical treatment, while only 3.7 per cent recovered without surgical treatment. A critical review of the 6 cases which recovered without operation fails to find any evidence of an intraperitoneal drainage of bile. Ricketts reported 49 instances of traumatic rupture of the gall bladder; 29 were operated upon, of which 22 recovered and 7 died; 20 were not operated upon, of which 4 recovered and 16 died. The duration of symptoms of the 16 cases which died without operation varied from 15 hours to 178 days. The prevailing cause of death as demonstrated by necropsy was peritonitis. Of the 4 patients who recovered without operation, the establishment of a fistula prevented death in 2 cases; in the third no evidence of an intraperitoneal drainage of bile was presented, while the fourth case is difficult to believe. Sabatier reported this case, which lived for 7 years following injury. "At necropsy the gall bladder was empty and the peritoneal cavity was filled with pure bile." In this series of 49 cases of traumatic etiology 75.8 per cent recovered after operation, while only 20 per cent recovered without an operation. The period of operation varied from immediately after the injury to several weeks later. The amount of fluid removed varied from a few ounces to 3 gallons and has been described as pure bile, blood, or pus, one or all combined. Death has been due to shock, infection, and hæmorrhage, and has taken place from 1 hour to several weeks after the injury.

Amante collected 101 instances of rupture of the biliary passages and states that without intervention such an injury is usually fatal, due to the toxæmia from the absorbed bile.

In 1918 Buchanan collected 17 cases of rupture of the gall bladder with a mortality of 9 out of 17 cases. Twelve of the 14 cases which were complicated by infection were treated surgically with a mortality rate of 50 per cent. Both of the patients not operated upon died. The 3 patients with a traumic history were treated surgically with a mortality rate of 33

[1]This work has been done under a grant from the Douglas Smith Foundation of Medical Research of the University of Chicago. This paper was read before the Chicago Surgical Society, November 7, 1930.

TABLE I.—THE EFFECT OF AN INTRAPERITONEAL INJECTION OF BILE UPON THE INTENSITY OF THE PETTENKOFER REACTION OF BLOOD

Dog	C.cm. of bile per kilogram	Before operation	Hours after the injection							Result
			0.5	1.5	2.5	3.5	4.5	5.5	24	
1	1	3.65	6.06	8.62	7.46	6.94	5.98	5.32	3.78	Recovered
2	1	5.86	6.42	7.35	5.01	4.84	5.32	5.15	5.40	Recovered
3	1	3.88	4.13	4.54	4.00	3.93	4.27	3.74	3.92	Recovered
4	1	3.57	4.56	4.84	3.78	3.52	3.26	3.40	3.32	Recovered
5	1	5.25	7.04	7.63	6.70	5.77	5.32	5.62	5.10	Recovered
6	2	5.34	7.01	10.41	7.63	7.46	5.71	4.79	5.43	Recovered
7	2	4.36	8.56	17.01	10.57	6.63	5.78	5.67	5.85	Recovered
8	2	5.55	5.39	7.14	4.63	4.98	4.34	5.23	5.46	Recovered
9	2	5.28	8.19	12.34	7.14	5.32	4.71	4.79	5.23	Recovered
10	3	4.41	5.67	7.03	5.81	5.63	5.45	5.20	4.63	Recovered
11	3	4.14	9.37	10.71	5.38	5.35	4.41	4.46	3.91	Recovered
12	3	3.79	6.33	9.26	8.20	5.32	5.21	4.43	4.14	Recovered

Pettenkofer values in terms of milligrams of glycocholic acid per 100 c.cm. of blood.

per cent. In 8 cases the duration of symptoms varied from 1 to 6 days with a mortality rate of 50 per cent. In 5 cases the duration of symptoms varied from 7 to 27 days with a mortality rate of 80 per cent.

A number of investigators have studied this problem and have concluded that sterile bile may be present in the peritoneal cavity without harm. Frankel and Krause, in 1899, injected bile into the peritoneal cavity of guinea pigs and dogs without observing untoward effects. After cutting the dogs' gall bladders with scissors the result was the same. When necropsies were performed 2 to 5 weeks later the wounds in the gall bladder had either healed or had been closed by omentum or loops of intestine.

Ehrhardt, in 1901, ligated the supraduodenal portion of the common bile duct of 12 dogs and cats, cut the duct above the ligature, and slit the proximal end of the duct a little. His animals died within 2 to 6 days with a progressive icterus. At necropsy the peritoneum was normal. He attributed the cause of death to the cholæmia from the absorbed bile. In two cats he cut a hole in the gall bladder and placed a culture of dead bacillus coli in the peritoneal cavity. Both animals were well at the end of 2 weeks. Two experiments done subsequently with staphylococcus gave the same results. Ehrhardt concluded then that bile depressed the virulence of bacteria and that injection protected against death from cholæmia.

Noetzel, in 1910, cut a hole in the gall bladder of each of 17 rabbits. Sixteen recovered and only 1 died. Noetzel concluded from that that the wounds of the gall bladder heal rapidly and that the escape of bile into the peritoneal cavity is innocuous.

Wagensteen, in 1926, showed that the establishment of a well functioning fistula is essential to determine the significance of the escape of sterile bile into the peritoneal cavity. After ligating the common bile duct in 6 dogs and cutting a hole in the gall bladder, these animals died within 24 hours. The procedure was repeated in rabbits with the same result. In 4 other dogs the common bile duct was divided and the distal end ligated. These dogs died within 48 hours. The experiment was repeated in rabbits with the same result. The bile in the peritoneal cavity at necropsy was sterile, consequently he attributed the cause of death to the toxicity of the bile.

Horrell, in 1929, confirmed the findings of Wagensteen by observing that in the dog the continuous drainage of bile into the peritoneal cavity is fatal within 24 hours. He attributed the deaths to the toxicity of the bile salts. As bile peritonitis is considered a toxæmia, experiments were made to test this hypothesis.

TABLE II.—THE EFFECT OF AN INTRAPERITONEAL INJECTION OF BILE UPON THE LEVEL OF BILIRUBIN IN BLOOD

Dog	C.cm. of bile per kilogram	Before operation	Hours after the injection						
			0.5	1.5	2.5	3.5	4.5	5.5	24
1	1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	1	0.0	Trace	Trace	Trace	0.0	0.0	0.0	0.0
6	2	0.0	0.0	Trace	Trace	0.0	0.0	0.0	0.0
7	2	0.0	0.0	Trace	0.0	0.0	0.0	0.0	0.0
8	2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9	2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10	3	0.0	Trace	Trace	Trace	0.0	0.0	0.0	0.0
11	3	0.0	Trace	Trace	Trace	0.0	0.0	0.0	0.0
12	3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

METHODS

Bilirubin was determined quantitatively by the Van den Bergh method and the bile salts by the quantitative Pettenkofer reaction devised by Aldrich.

Experiments. In this experiment the effect of an intraperitoneal injection of bile was measured by determining the amount of bilirubin and bile salts which were entering the blood. These determinations are charted on Tables I and II and show that only minor and transient changes in the blood occur when bile is administered intraperitoneally.

Bile peritonitis was then produced by allowing bile to drain continuously into the peritoneal cavity. This was done by making a stoma in the gall bladder after the ductus choledochus was ligated and divided. The effect of this procedure was then studied by determining the amounts of bilirubin and bile salts entering the blood. No increase in bilirubin and bile salts could be detected in blood drawn 18 hours after the bile was allowed to drain into the peritoneal cavity, even though these animals were moribund as to the result of this procedure. These observations show that the cause of death is obviously not the circulation of the bile salts in the blood at toxic levels.

Of the 20 dogs in this experiment, 6 were dead and 14 were moribund 18 hours after their operations. Necropsies were performed (immediately after the electrocution of the living animals, and on the ones found dead) and may be summarized as follows:

The peritoneal cavity presented the picture of an acute severe general peritonitis and contained several hundred cubic centimeters of a bile stained serosanguineous exudate. The peritoneum was fiery red, numerous petechiæ and small subperitoneal hæmorrhages were present and the peritoneal surfaces were covered with a thin layer of fibrin. Around the pancreas were a few small areas of fat necrosis.

This peritoneal exudate contained polymorphonuclear leucocytes and large gram positive bacilli. The results of a bacteriological study of this exudate are recorded in Tables III and IV and show the presence of a gram positive bacillus which grew exceedingly well under anaerobic conditions, and which was present in the peritoneal exudates of all of the twenty dogs in this series. Aerobic cultures of this exudate contained organisms in two instances; in one staphylococcus aureus was present, in the other both staphylococcus aureus and bacillus coli were observed. The presence of these aerobic organisms may be accounted for on the basis of either contamination or postmortem invasion. Since the anaerobic gram positive bacillus was present in the exudates of all of the dogs, its presence must be significant if it is possible to exclude contamination and postmortem invasion. The

TABLE III.—BACTERIOLOGICAL STUDIES OF BILE PERITONITIS

Dog	Smear	Aerobic blood agar plate	Anaerobic meat	Anaerobic blood agar plate	Remarks
13	Gram+bacillus	No growth	Gram+bacillus	1. Gram+bacillus 2. Gram+coccus in clusters 3. Gram−bacillus	Killed
14	Gram+bacillus pus cells	No growth	Gram+bacillus	Gram+bacillus	Fresh autopsy
15	Gram+bacillus pus cells	No growth	Gram+bacillus	Gram+bacillus	Killed
16	Gram+bacillus pus cells	1. Bacillus coli 2. Staphylococcus aureus	Gram+bacillus	Gram+bacillus	Found dead
17	Gram+bacillus pus cells	1. Staphylococcus aureus	Gram+bacillus	Gram+bacillus	Killed
18	Gram+bacillus pus cells	No growth	Gram+bacillus	Gram+bacillus	Found dead
19	Gram+bacillus pus cells	No growth	Gram+bacillus	Gram+bacillus	Killed
20	Gram+bacillus	No growth	Gram+bacillus	Gram+bacillus	Killed

media previous to use in this experiment was sterile after 24 hours of incubation. Inasmuch as this organism is not a common contaminant, it seems that it would be incredible to contaminate twenty consecutive cultures with it. As for the possibility that it might be a postmortem invader, the following data is of interest. In this series of 20 dogs, 14 had been killed immediately before the bacteriological study was made. Since this organism was present in both the smears and cultures of this exudate, it seems reasonable to assume that they were present during life if it can be shown that postmortem invasion does not occur within 2 minutes after electrocution. Five normal, healthy dogs were electrocuted, their abdomens immediately opened and a bacteriological study made of their peritoneal cavities. Milk media was used in this experiment and the results are recorded in Table V. These cultures were all sterile except one, in which grew staphylococcus aureus, a contaminant, and shows conclusively that postmortem invasion does not take place under the conditions of this experiment and that the cultures of the 14 dogs taken immediately after electrocution represent the condition which existed during life. The question then arose as to how soon following the operation did this large gram positive bacillus invade the peritoneal cavity. A bacteriological study of the peritoneal exudates of 24 dogs with bile draining into their peritoneal cavities was made at intervals of 2½, 5, and 10 hours after their operations. The results are recorded in Table VI and may be summarized as follows: In the dogs of the 2½ hour class organisms were present in 5 of 8 dogs. In one animal large gram positive anaerobic bacilli and gram positive cocci in chains were observed. The streptococcus and bacillus coli were present in the exudates of the 4 other dogs. In the 5 hour class the anaerobic bacillus was present in 4 of the 8 dogs; and in the 10 hour class, in 7 of 8. In experiments of longer duration the streptococcus and bacillus coli were present in relatively fewer numbers. The fact that in the later hours of the experiment this gram positive bacillus was present in nearly pure culture may be explained on the basis of an over-growth phenomenon. Although organisms other than this anaerobic bacillus have invaded the peritoneal cavity along with the anaerobic bacillus early in the experiment, the latter organism grew more rapidly so that when cultures were made 18 hours after the operation, only the anaerobic bacillus was to be found.

Since the gram positive bacillus was present in both the smears and cultures of the exudates of twenty dogs in all instances, and that contamination antemortem and postmortem invasion have been excluded, this anaerobic bacillus should be considered as a possible cause of the peritonitis.

A study of the peritoneal reaction to this organism was then made by introducing broth cultures of it intraperitoneally and a peritonitis identical with bile peritonitis was produced. Cultures of the resulting exudate contained anaerobic gram positive bacilli identical culturally with those isolated from dogs

TABLE IV.—BACTERIOLOGICAL STUDY OF BILE PERITONITIS

Dog	Exudate smear	Anaerobic meat media	Smear	Anaerobic milk media	Smear	Remarks
21	Gram + bacillus	Gas + turbidity	Gram + bacillus	Stormy fermentation	Gram + bacillus	Killed
22	Gram + bacillus	Gas + turbidity	Gram + bacillus	Stormy fermentation	Gram + bacillus	Killed
23	Gram + bacillus pus cells	Gas + turbidity	Gram + bacillus	Stormy fermentation	Gram + bacillus	Killed
24	Gram + bacillus pus cells	Gas + turbidity	Gram + bacillus	Stormy fermentation	Gram + bacillus	Killed
25	Gram + bacillus pus cells	Gas turbidity	Gram + bacillus	Stormy fermentation	Gram + bacillus	Killed
26	Gram + bacillus pus cells	Gas turbidity	Gram + bacillus	Stormy fermentation	Gram + bacillus	Found dead in cage
27	Gram + bacillus pus cells	Gas turbidity	Gram + bacillus	Stormy fermentation	Gram + bacillus	Found dead in cage
28	Gram + bacillus pus cells	Gas turbidity	Gram + bacillus	Stormy fermentation	Gram + bacillus	Killed
29	Gram + bacillus pus cells	Gas turbidity	Gram + bacillus	Stormy fermentation	Gram + bacillus	Killed
30	Gram + bacillus pus cells	Gas turbidity	Gram + bacillus	Stormy fermentation	Gram + bacillus	Found dead in cage
31	Gram + bacillus pus cells	Gas turbidity	Gram + bacillus	Stormy fermentation	Gram + bacillus	Killed
32	Gram + bacillus pus cells	Gas turbidity	Gram + bacillus	Stormy fermentation	Gram + bacillus	Killed

dying of bile peritonitis. The results of this experiment are recorded in Table VII. Inasmuch as it was necessary to introduce at least 20 cubic centimeters of a culture in order to produce a fatal peritonitis, and that necropsies of animals receiving less furnished no evidence of a previous inflammatory process, the question then arose as to whether the bile was lowering the peritoneal resistance to infection. When mixtures of bile and broth cultures in sublethal amounts were introduced into the peritoneal cavity, it was possible to lower the minimal lethal dose of a broth culture from 20 to 5 cubic centimeters, showing that the presence of bile facilitates the development of peritonitis. This experiment is described in Table VIII.

The source of this infection was the next problem to be solved. Were the organisms entering the peritoneal cavity with the bile, or was the bile altering the permeability of viscera containing bacteria to permit peritoneal invasion? Cultures of bile removed from the gall bladders of 20 dogs at the time of operation were all sterile except one, in which grew a short gram negative bacillus. This experiment shows that the bile of healthy dogs is sterile.

The effect of sterile bile salt solutions on the peritoneum was then studied. A 10 per cent solution of bile salts, filtered through a Berkfield filter and shown to be sterile when introduced into the peritoneal cavity, was administered in amounts varying from 2.5 to 4 cubic centimeters per kilogram of body weight. The appearance of the peritoneal cavity was essentially the same as was observed in bile peritonitis, except that fat necrosis was more extensive. The serosanguineous exudate contained polymorphonuclear leucocytes and large gram positive bacilli which had the same morphologic and cultural characteristics as those organisms observed in bile peritonitis. Of this series of 20 dogs, 11 had died and 9 were moribund 18 hours after the bile salts solution had been introduced through a laparotomy incision. Since it was possible to find this organism in the exudates of 19 dogs and that 8 of these had been killed immediately before the cultures were taken, it seems reasonable to assume that these organisms had invaded the peritoneal cavity during life and that they were not postmortem invaders. The results of this experiment are recorded on Table IX and show that a septic peritonitis may be produced by sterile bile salt solutions and suggest a new mechanism for infection.

This bacillus, an anaerobic organism, grows readily in broth, and in milk produces a stormy fermentation within 18 hours. On an anaerobic blood agar plate the colony is large, is gray in color, and is surrounded by a zone

TABLE V.—CULTURES OF THE NORMAL PERITONEUM OF DOGS TAKEN WITHIN TWO MINUTES AFTER ELECTROCUTION

		Duration of incubation		
		24 hrs.	48 hrs.	72 hrs.
Dog A	a	No growth	No growth	No growth
	b	No growth	No growth	No growth
Dog B	a	No growth	No growth	No growth
	b	No growth	Staph. aureus	Staph. aureus
Dog C	a	No growth	No growth	No growth
	b	No growth	No growth	No growth
Dog D	a	No growth	No growth	No growth
	b	No growth	No growth	No growth
Dog E	a	No growth	No growth	No growth
	b	No growth	No growth	No growth

TABLE VI.—THE PRESENCE OF ANAEROBIC BACILLI IN THE PERITONEAL EXUDATES OF LIVING DOGS WITH BILE PERITONITIS

Number of dogs	Bile draining into the peritoneal cavity for a period of	Anaerobic bacilli present in the exudate of	Percentage of positive cultures
8	2.5 hrs.	1 dog	12.5 per cent
8	5.0 hrs.	4 dogs	50.0 per cent
8	10.0 hrs.	7 dogs	87.5 per cent

TABLE VII.—PERITONITIS PRODUCED BY EIGHTEEN HOUR BROTH CULTURES OF THE ANAEROBIC BACILLUS

No. of dogs	Amount of culture in c.cm.	Results
1	50	Death within 18 hrs.
1	40	Death within 18 hrs.
1	30	Death within 18 hrs.
3	20	Death within 18 hrs.
3	15	Recovery
1	10	Recovery
1	5	Recovery

TABLE VIII.—THE EFFECT OF THE INTRAPERITONEAL ADMINISTRATION OF MIXTURES OF BILE AND BROTH CULTURES

No. of dogs	C.cm. of bile per kilogram	C.cm. of culture introduced	Results
2	1	15	Death within 18 hrs.
2	1	10	Death within 18 hrs.
2	1	5	Death within 18 hrs.

of beta hæmolysis. It stains well with methylene blue and positively by Gram's method. It varies considerably in length, has flat ends and produces spores. In smears it appears singly, in pairs, or in short chains. This organism has the same morphology and cultural characteristics as bacillus welchii and in the remainder of the paper it will be referred to as bacillus welchii.

Wagensteen and Horrall in recent investigations showed that the continuous drainage of bile into the peritoneal cavity produced a fatal peritonitis in dogs and attributed the cause of death to the toxicity of the bile. Experimental data, however, shows that the cause of death in bile peritonitis is not due to the circulation of the bile salts in the blood at toxic levels because no increase of bilirubin or bile salts was found even though the dogs were moribund as the result of peritonitis. The cause of death must be due to the local action of the bile in the peritoneal cavity and the secondary changes produced by it.

The finding of bacillus welchii in the peritoneal exudates of 20 dogs dying from bile peritonitis suggested the septic nature of the process. The production of an inflammation identical with bile peritonitis by cultures of this organism supports this concept. Observations are presented which show that bacillus welchii is not a normal inhabitant of the bile but invades the peritoneal cavity as the result of the local action of the bile salts on the viscera containing bacteria. The most probable explanation of this phenomenon is on the basis of permeability changes which are produced by the bile salts.

CONCLUSIONS

1. Bile peritonitis in dogs is an infection.
2. Bacillus welchii invades the peritoneal cavity, presumably as the result of permeability changes produced by the local action of the bile salts in the peritoneal cavity.
3. A peritonitis identical with bile peritonitis was produced by bacillus welchii.
4. Examination of the blood for bilirubin and bile salts is of no value in determining the amount of drainage of bile into the peritoneal cavity.
5. These conclusions are confined to the action of bile on the dog's peritoneum.

TABLE IX.—A BACTERIOLOGICAL STUDY OF EXPERIMENTAL BILE SALTS PERITONITIS

Dog	Cultures of normal peritoneum in milk	Cultures of bile salt filtrate in milk	Peritoneal exudate cultured in					
			Exudate smear	Meat (anaerobic)	Smear	Milk	Smear	Remarks
33	No growth	No growth	Gram+rod pus cells	Gas−turbidity	Gram+bacillus	Stormy fermentation	Gram+bacillus	Killed
34	No growth	No growth	Gram+rod pus cells	Gas−turbidity	Gram+bacillus	Stormy fermentation	Gram+bacillus	Killed
35	No growth	No growth	Gram+rod pus cells	Gas and turbidity	Gram+bacillus	Stormy fermentation	Gram+bacillus	Found dead
36	No growth	No growth	Gram+rod pus cells	Gas and turbidity	Gram+bacillus	Stormy fermentation	Gram+ fermentation	Found dead
37	No growth	No growth	Gram+rod pus cells	Gas and turbidity	Gram+bacillus	Stormy fermentation	Gram+bacillus	Fresh autopsy
38	No growth	No growth	Gram+rod pus cells	Gas and turbidity	Gram+bacillus	Stormy fermentation	Gram+bacillus	Found dead
39	No growth	No growth	Gram+rod pus cells	Gas and turbidity	Gram+bacillus	Stormy fermentation	Gram+bacillus	Found dead
40	No growth	No growth	Gram+rod pus cells	Gas and turbidity	Gram+bacillus	Stormy fermentation	Gram+bacillus	Found dead
41	No growth	No growth	Gram+rod pus cells	Gas and turbidity	Gram+bacillus	Stormy fermentation	Gram+bacillus	Fresh autopsy
42	No growth	No growth	Pus cells	No growth	Negative	No growth	Negative	Killed
43	No growth	No growth	Gram+rod pus cells	Gas and turbidity	Gram+bacillus	Stormy fermentation	Gram+bacillus	Found dead
44	No growth	No growth	Gram+rod pus cells	Gas and turbidity	Gram+bacillus	Stormy fermentation	Gram+bacillus	Fresh autopsy
45	No growth	No growth	Gram+rod pus cells	Gas and turbidity	Gram+bacillus	Stormy fermentation	Gram+bacillus	Fresh autopsy
46	No growth	No growth	Gram+rod pus cells	Gas and turbidity	Gram+bacillus	Stormy fermentation	Gram+bacillus	Fresh autopsy
47	No growth	No growth	Gram+rod pus cells	Gas and turbidity	Gram+bacillus	Stormy fermentation	Gram+bacillus	Killed
48	No growth	No growth	Gram+rod pus cells	Gas and turbidity	Gram+bacillus	Stormy fermentation	Gram+bacillus	Killed
49	No growth	No growth	Gram+rod pus cells	Gas and turbidity	Gram+bacillus	Stormy fermentation	Gram+bacillus	Killed
50	No growth	No growth	Gram+rod pus cells	Gas and turbidity	Gram+bacillus	Stormy fermentation	Gram+bacillus	Killed
51	No growth	No growth	Gram+rod pus cells	Gas and turbidity	Gram+bacillus	Stormy fermentation	Gram+bacillus	Killed
52	No growth	No growth	Gram+rod pus cells	Gas and turbidity	Gram+bacillus	Stormy fermentation	Gram+bacillus	Killed

REFERENCES

1. ALDRICH, M., and BLEDSOE, M. S. Studies in metabolism of bile. J. Biol. Chem., 1928, lxxvii, 519.
2. AMANTE. Quoted by Kehr, 1912.
3. BUCHANAN, J. J. Surg., Gynec. & Obst., 1918, xxvi, 303.
4. COURVOISIER, L. G. Casuistisch. Statistische Beitraege zur Pathologie und Chirurgie der Gallenwege, pp. 152–170. Leipzig, 1890.
5. EHRHARDT, O. Arch. f. klin. Chir., 1901, lxiv, 314.
6. Ibid., 1904, lxxiv, 658.
7. ERDMANN, J. F. Ann. Surg., 1903, xxxvii, 878.
8. FRAENKEL, E., and KRAUSE, P. Bacteriologisches und Experimentelles ueber die Galle. Ztschr. f. Hyg. u. Infectionskrankenh., 1899, xxxii, 97.
9. HORRELL, O. H. Arch. Int. Med., 1929, xliii, 114.
10. KEHR, HANS. Chirurgie der Gallenwege. Neue Deutsche Chir., vol. viii, 1913.
11. MCWILLIAMS, C. A. Am. J. Surg., 1912, lv, 235.
12. NOETZEL, W. Arch. f. klin. Chir., 1910, xciii, 100.
13. RICKETTS, B. M. St. Louis M. Rev., 1905, li, 108, 233, 276, 456, 476, 497; lii, 4, 25.
14. SABATIER. Medicine Operatoire. Vol. i, p. 43. Paris, 1796.
15. WAGENSTEEN, O. H. Ann. Surg., 1926, lxxxiv, 691.

TRANSPLANTATION OF THE URETERS TO THE SIGMOID

An Experimental Study in Dogs

IRA R. SISK, M.D., F.A.C.S., JOHN B. WEAR, M.D., and HAROLD A. O'BRIEN, M.D., Madison, Wisconsin
Department of Urology, University of Wisconsin School of Medicine

BELIEVING that the development and execution of a surgical procedure must have a clear and well understood physiological and pathological background, we have undertaken this animal experimentation. The surgical technique of ureteral transplantation has made rapid progress since 1909, but for obvious reasons there has not been a corresponding progress in the end-results of such cases. Overenthusiasm can do irreparable damage to any new surgical procedure unless the limitations and possible remote changes in the organism are well understood. A study of the current literature suggests that we are approaching such a state in transplantation of the ureters into the large bowel. We believe that the techniques variously advocated are not sufficiently stabilized for the operation to be regarded lightly.

The battlefront of investigation has been far flung, but the privilege of employing this operation in a number of human patients has fallen to only a few men. For that reason reported efforts of isolated investigators on a small scale will aid in completing the picture.

An extensive review of the literature would be futile at this time. Only those articles which are pertinent to the purpose of this paper are included for discussion. The development of Coffey's technique is the most significant factor on this subject in the American literature. His three major contributions were: (1) the mucous membrane valve which adequately prevents regurgitation of fæcal material up the ureter; (2) the use of tubes to prevent postoperative occlusion of the ureters; (3) the extensive cleansing of the lower bowel to insure a relatively sterile operative field.

In 1929 he reported 20 cases on whom this technique had been used. Autopsies were done on 3 of the 5 patients who died. Two of the three, Cases 7 and 8, had extensive carcinomata of the bladder and died 75 and 290 days after operation. Microscopic examination of the kidneys showed a mild leucocytic infiltration and parenchymatous degeneration. One, Case 20, died 6 days after operation and the pathologist found normal kidneys. From his own personal experience he believes that both the problem and the technique have been solved and that the operation may be safely recommended to skilled surgeons.

To C. H. Mayo belongs the credit for the widest clinical experience with ureteral transplantation. In 1924, he reported a series of 35 cases. Both ureters were transplanted in 28 patients; 1 died of peritonitis and 23 patients have been followed. Five complain of lumbar pain at times; otherwise there are no complaints. Mayo's technique differs from the completed Coffey technique in that (1) he does the operation in two stages; (2) he does not use tubes; and (3) he does not clean the lower bowel so extensively. The one step common to both is the mucous membrane valve, yet their results are quite parallel.

After noting these two procedures and results, a study of Turner's review of 17 personal cases is interesting if not confusing. He used neither the Coffey nor Mayo techniques but that of Stiles, which does not form a mucous membrane valve. There were 4 deaths, 3 from peritonitis and 1 due to septic dermatitis. There are 10 patients living and well from 7 months to 15 years after operation. The report is particularly valuable because it contains full follow-up notes on the living and the autopsy records of the dead. One patient died 3 years after operation from intestinal obstruction, and 1 died 2 years after operation from a plastic operation on the bladder. The progress in these cases up to the time of death did not indicate renal infection, but autopsy revealed a pyonephrosis in 1 case and a hydronephrosis with dilated ureter in the other case.

Turner urges particularly that as much of the blood supply to the ureters as possible be saved and in his operation he stresses: (1) the two-stage operation; (2) the Mayo catgut urine guide; and (3) a drain tube from the area of anastomosis. He has also observed the frequency of attacks of renal infection soon after the operation, from which the patient readily recovers, and he believes that moderate renal infection is not inconsistent with average good health. The more than casual relationship of an impeded opening into the bowel to infection has also been recognized by Turner. He could not force water up the ureters in his autopsy specimens.

The three foregoing clinical reports, although the cream of the current literature, offer little aid in studying the pathology and physiology of transplanted ureters. To depend upon the human subject for this information means many years of waiting, and then the reported cases will be few and scattered. Obviously then, animals offer a solution, and to McKenna belongs the credit for studying end-results over a period of time. His was the first work in which dogs lived for more than a year with a transplanted ureter. The successful results which he published prompted us to apply this investigation with a broader purpose. He transplanted one ureter by the Coffey technique, and 3 dogs were allowed to live 14 months and 1 dog 24 months. He studied the function and bacteriology. In every case the function was normal in the transplanted kidney, and cultures from both sides were sterile. Our experience with the operation in dogs has not been as satisfactory as McKenna's, and we believe it will show that the last word has not been said concerning renal infection.

Female dogs were used in this work because the external male genitalia interfere both with the surgical exposure and the cleanliness of the operative field. On the whole, dogs are well adapted for this type of investigation. However, they do not withstand infection very well because of poor general resistance and the highly virulent bacteria present in the normal intestinal flora. The only technical difficulty arises from the thick and rigid muscular coat of the bowel wall, which makes closure of the anastomosis more difficult and less secure than in the human. We believe that our results demonstrated that in these animals the operative technique may be executed with relative ease and that peritonitis arising from soiling by the opening of the bowel, even though no drainage is used, is not a serious factor. In only one animal did we feel that peritonitis was caused by soiling at the time of the operation. Two other animals developed peritonitis; in one it resulted from a severe wound infection and in the other from evisceration in a pregnant dog in which operation was attempted too near term.

This study is composed of 31 operations performed on 29 dogs. One of the purposes of the work was to compare the end-results of ureteral transplantation, when the techniques as described by Mayo and Coffey in the individual reports of their work were used. The operative techniques have been so fully described elsewhere that no details need be given here. In every case we used the submucous implantation as originally developed by Coffey. In one group of cases we followed the operative technique as described by Mayo, allowing for single transplantation, and in the second major group we followed the recent technique of Coffey, permitting bilateral transplantation by using ureteral catheters as well as the cleansing of the lower bowel.

Hence, we shall hereafter refer to the one as the Mayo technique, in which no ureteral catheters were used, and designate as the Coffey operation that which followed the operative technique described in Coffey's later publication.

MAYO TECHNIQUE; ONE URETER TRANSPLANTED

In 7 animals, 1, 4, 5, 6, 7, 8, and 11, a single ureter was transplanted by the Mayo technique. Dog 1 was killed on the seventh day because of complete evisceration of the abdominal contents. Two died on the fifty-sixth and ninety-fourth days, and for various reasons the others were killed on the thirty-second, fifty-sixth, sixty-eighth, and one hundred nineteenth days. The complete records of these dogs follows.

Dog 1. The right ureter was transplanted into the sigmoid June 6, 1929. The dog was killed 7 days later because of complete evisceration. The autopsy showed a small amount of pus in the right perirenal area. Neither the ureter nor the pelvis of the right kidney were dilated. The area of the anastomosis was well healed and showed no evidence of leakage. The right kidney, ureter, and the sigmoid were removed intact. When the sigmoid was opened, no ureteral opening could be demonstrated, and a fine probe passed down the ureter presented beneath the mucosa which was smooth in this area. No microscopic sections were obtained.

Dog 4. The right ureter was transplanted into the sigmoid July 7, 1929. The dog recovered without incident but contracted mange so badly that it was necessary to kill her November 25, 119 days after operation. The peritoneum was smooth and glistening throughout. There were a few adhesions in the region of the anastomosis. The right kidney, ureter, and the sigmoid were removed intact. The pelvis and ureter were not dilated, but the kidney was one-third as large as the left. The area of the anastomosis was perfectly healed. On gross section there was much fibrosis in the cortical area of the right kidney. A No. 4 pointed ureteral catheter passed down the ureter entered the sigmoid without obstruction. The left kidney appeared entirely normal. No gross evidence of pus was found in urinary tract. The non-protein nitrogen content before death was 35 milligrams.

Microscopic sections of the right kidney showed a diffuse cellular infiltration, with marked fibrosis throughout. Sections of the left kidney showed extensive cloudy swelling of the tubules and glomeruli but no evidence of pyogenic infection.

Dog 5. The right ureter was transplanted August 2, 1929. Due to the fact that the dog contracted distemper and was losing weight rapidly, she was anæsthetized September 9, 32 days after operation, in order to have a comparison of the two kidneys before death. There were no adhesions in the abdomen, and the anastomosis was perfectly healed. The right kidney was twice the size of the left; it was dark in color and showed many dilated veins over the surface. The right ureter was dilated to the size of a lead pencil. An opening was made in each ureter and catheters were introduced. About 75 cubic centimeters of cloudy urine, which showed pus IV were immediately obtained from the right kidney. Urine from the left kidney showed an occasional pus cell. Both right and left sides showed bacillus coli on culture. Functional test was unsatisfactory because of small amount of urine obtained.

The dog was killed with chloroform and the right kidney, ureter, and sigmoid were removed intact. The left kidney was also removed. A No. 4 ureteral catheter could not be passed down the ureter into the sigmoid, as the opening in the mucous membrane had healed completely. The mucous membrane in area over end of catheter showed no rugæ.

Microscopic section of the right kidney showed an inflammatory reaction throughout the pelvis and cortex, with cellular infiltration. Some areas of the cortex contained small abscesses. Sections of the left kidney showed only cloudy swelling.

Dog 6. The right ureter was transplanted August 7, 1929. The dog recovered from the operation without incident and from then on never appeared to be sick and seemed well the day before death November 9, 94 days after operation.

At autopsy the operative wound was healed. The peritoneum was smooth and glistening, and there was no fluid in the abdomen. The anastomosis was in good condition. The right kidney was very small, about one-half the size of the left. The right ureter was slightly larger than the left, and the right pelvis was slightly dilated. The right kidney, ureter, and sigmoid were removed intact. The left kidney and a portion of the left ureter were also removed. The wall of the sigmoid was quite thin and no rugæ were present. A small ureteral catheter passed down the ureter would not enter the sigmoid because opening had been closed by mucous membrane of bowel. There was no gross evidence of pus in either kidney.

Microscopic study of the right kidney showed the changes of acute inflammation, with cellular infiltration throughout. The left kidney showed only cloudy swelling.

Dog 7. The right ureter was transplanted August 13, 1929. The dog recovered nicely from the operation and was quite active for a month. She then began to refuse her food and looked sick. This downward course was progressive, and she died October 8, 56 days after operation.

At autopsy the operative scar was well healed. The abdomen was markedly distended. When the peritoneum was opened it was found to be flaming red, and a large amount of blood-tinged pus was seen to fill the entire abdomen. The right kidney was three times the size of the left. The upper pole was soft and necrotic, and fluid was seen to ooze out. The ureter was dilated about three times normal size. The right kidney, ureter, and a portion of the sigmoid were removed intact. The kidney was opened and found to be a mere shell. The cortex was perforated at the upper pole. A No. 6 catheter passed into the sigmoid without obstruction.

Microscopic study of the right kidney showed a dense infiltration with polymorphonuclear leucocytes throughout the whole organ. In one area a large blood clot was seen. Scattered areas of fibrous tissue formation were seen in the cortex. The left kidney showed a diffuse cloudy swelling.

Dog 8. The right ureter was transplanted August 19, 1929. In this operation the catgut urine guide was not used. The dog progressed well for 1 month and then began to lose weight and strength. On October 14, 56 days after operation she was anæsthetized in order to study the function of the kidneys and to obtain urine cultures. The previous operative scar was well healed, and the peritoneum was normal. There were many adhesions in the area of the ureteral anastomosis. Both kidneys were normal in size and color. The right ureter was dilated to the

size of a lead pencil. The ureters were opened and catheters tied in. Thick pus was obtained from the right side, but urine from the left kidney showed a very occasional pus cell. Cultures from both sides showed bacillus coli. A functional test was done. The dye appeared on the left side in 3 minutes in concentration IV, but no dye appeared on the right side in 30 minutes.

The dog was then killed with chloroform and the right kidney, ureter, and sigmoid were removed intact. The right kidney consisted of practically a mere shell of tissue. A small ureteral catheter passed down the ureter met obstruction just beneath the mucosa of the sigmoid and no opening could be demonstrated.

Microscopic sections of the right kidney showed a dense infiltration of leucocytes in the submucosa and mucosa of the pelvis. There were multiple abscesses in the cortex. The left kidney showed a lymphocytic invasion of the submucosa of the pelvis. There was no evidence of pyogenic infection elsewhere. There was a diffuse cloudy swelling.

Dog 11. The right ureter was transplanted September 18, 1929. The postoperative progress was uneventful for 1 month, and then she contracted mange which caused her to become quite weak and emaciated.

An attempt was made to anæsthetize the animal November 25, 68 days after operation, but she died before urine specimens could be obtained. The peritoneum was normal, and there were no adhesions in the abdomen. The right kidney was one-half the size of the left, and the right ureter was twice the size of the left. The pelvis of the kidney was not dilated and the lining was smooth and glistening. The right kidney and ureter were removed with the sigmoid. The right ureter was patent throughout except at the opening into the sigmoid, which was closed over by the mucous membrane of the bowel.

Microscopic sections of the right kidney showed a dense invasion of the submucosa of the pelvis with polymorphonuclear leucocytes and lymphocytes. There were no cellular products of inflammation in the cortex, which showed an extensive cloudy swelling. The left kidney showed no evidence of pyogenic infection but did show a marked cloudy swelling.

Although the Mayo catgut urine guide was used in all the cases except dog 8, the ureteral opening was closed by bowel mucosa in 5 of the 7 cases. It will be noted that this closure of the ureterosigmoidal opening occurred even in dog 1, which was killed on the seventh postoperative day.

In one (dog 7) the ureter was patent throughout, but the animal died from rupture of a pyonephrosis on the side of the transplanted ureter. The best result in the group seemed to be dog 4, in which there was no gross evidence of infection but the kidney was quite small as compared with the side not operated upon. However, microscopic examination of this kidney showed marked fibrosis, cellular infiltration, and destruction of the glomeruli by fibrous tissue.

In only 2 cases in this group (dogs 5 and 8) were cultures taken from both kidneys just before death, and in each case the cultures showed a bacillus coli infection in the untransplanted as well as the transplanted side.

We did not obtain a satisfactory result in a single case in this group, the failure being attributed to closure of the ureterosigmoidal opening and to renal infection.

MAYO TECHNIQUE; BOTH URETERS TRANSPLANTED

In 3 animals both ureters were transplanted by the Mayo technique. Both ureters were transplanted at one operation in dog 26, and death occurred on the third day, apparently from uræmia. No autopsy was done. In dog 2 the left ureter was transplanted 16 days after the right. Death occurred 6 days after the second operation, due to a localized peritonitis resulting from soiling at the time of the second operation. In dog 3 the left ureter was transplanted 70 days after the right and death occurred 53 days later. Both ureters were open but stenosed, and cultures showed streptococci on the right and bacillus coli on the left. Complete reports of dogs 2 and 3 follow:

Dog 2. The right ureter was transplanted July 3, 1929. Recovery was uneventful and 16 days later the left ureter was transplanted. The dog never appeared well after the second operation and died July 25, 6 days after the second operation.

At autopsy the operative wound was not healed. A localized area of pus was found in the left lower quadrant. No pus and no signs of infection were found elsewhere in the abdominal cavity. The ureters and kidneys appeared normal in size. The right anastomosis was well healed, and the left showed some soft adhesions but no signs of urinary leakage. Both kidneys, both ureters, and the sigmoid were removed. The pelvis and ureters were not dilated and showed no gross pus. A No. 5 ureteral catheter would not pass through the ureterosigmoidal openings, which were pin-point in size.

Microscopic sections of the right kidney showed a marked inflammatory reaction, with cellular infiltration throughout the organ. The left kidney showed a mild inflammatory infiltration in the mucosa of the pelvis and a marked destruction of the tubules and glomeruli by cloudy swelling.

Dog 3. The right ureter was transplanted July 22, 1929. The dog seemed quite well and 70 days later the left ureter was transplanted. For about 6 weeks she was active but then began to become gradually weaker and refused to eat. She was anæsthetized 53 days after the second operation in order to obtain urine cultures before death. The peritoneum was smooth and glistening. Both kidneys were enormously enlarged and both ureters were dilated and kinked. The anastomosis appeared normal. Ureteral catheters were tied in the ureters and cultures obtained, which showed streptococci on the right side and bacillus coli on the left side. Both sides showed much pus. The dog was killed and both kidneys and ureters were removed with the sigmoid. The ureterosigmoidal openings were patent but markedly stenosed.

Microscopic sections of the right kidney showed an extensive inflammatory reaction throughout the pelvis and cortex. The left kidney showed no cellular infiltration, but there was a marked congestion with hæmorrhage and an extensive destruction of the tubular epithelium by cloudy swelling.

The results in these 2 cases were obviously poor. Marked infection occurred in all four kidneys as was demonstrated by the microscopic sections. The pathological picture is essentially the same as was seen in the unilateral Mayo transplants.

COFFEY TECHNIQUE; BOTH URETERS TRANSPLANTED

In 8 animals, dogs 9, 10, 12, 13, 14, 21, 22, and 24, both ureters were transplanted at the same time by the Coffey tube technique. They lived from 7 to 31 days. The complete records of these 8 dogs are given below.

Dog 9. Both ureters were transplanted September 6, 1929. Following the operation the dog was quite sick for a few days, and the ends of the catheters had to be cut frequently to keep them draining. The first catheter came out on the ninth and the second came away on the tenth postoperative day. The stools were liquid from that time on. During the next week the dog appeared quite normal. She then began to lose weight quite rapidly and continued to marked emaciation. On October 6, 30 days after operation, the animal's condition was very poor, so anæsthesia was started in order to do functional tests and obtain urine cultures, but she died before the abdomen was opened.

At autopsy the peritoneum was smooth and glistening. There were a few adhesions in the lower abdomen. The right kidney appeared to be slightly enlarged, and the right ureter was larger than normal. The left kidney was three times the size of the right. There were many engorged vessels over its surface. On gross section this kidney showed a large hydronephrosis, the renal parenchyma being reduced to a mere shell, in which the normal markings were obscured. The left ureter was also about three times as large as the right and showed a kink in the lower third. Catheters passed down both ureters entered the sigmoid without obstruction.

Microscopic sections of the right kidney showed an extensive œdema throughout, with destruction of the tubular epithelium. There were many small cysts formed by rupture of the tubules. There were no cellular products of inflammation. The left kidney showed many small cysts in the cortex, and the blood vessels were dilated and full of blood. There was an extensive cloudy swelling. There was no evidence of pyogenic infection.

Dog 10. Both ureters were transplanted September 16, 1929, and 5 days later both catheters came out. Up until this time and for 24 hours afterward the dog appeared well, and the stools were liquid. On September 22 the dog appeared quite sick, and there was a purulent exudate from both eyes. Death occurred on the afternoon of September 23, 7 days after operation.

At autopsy the operative wound was not healed. There was free fluid in the abdomen and much pus in the pelvis as well as along the course of the left ureter. The ureters were not dilated. The right kidney was about twice the normal size and showed a reddish color. The left kidney was normal in size and color. The left anastomosis showed a partial separation from the sigmoid but the right was in good condition. Catheters passed down both ureters entered the sigmoid without obstruction.

Microscopic section of the right kidney showed complete destruction of kidney tissue throughout, with multiple abscesses. The left kidney showed no evidence of pyogenic infection, but there was a marked destruction of the tubular epithelium and the glomeruli by cloudy swelling.

Dog 12. Both ureters were transplanted September 19, 1929. At the time of operation it was noted that the dog was pregnant. Two days after operation the catheters came away. The condition of the dog seemed good and the stools were liquid. On September 25 the operative wound broke open and a small knuckle of gut protruded. Within a few minutes the dog was anæsthetized and a secondary closure of the abdominal wound was done. The dog died 7 days after operation.

At autopsy there was a large amount of free pus in the abdomen. The intestines were matted together. The right kidney was slightly larger than normal and the left was normal in size. The ureters were not dilated. The kidneys and ureters were removed with the sigmoid attached. The kidneys showed some congestion but no macroscopic pus. The anastomoses were healed. Catheters passed down both ureters entered the bowel without obstruction.

Microscopic section of the right kidney showed an inflammatory reaction, with a lymphocytic infiltration beneath the mucosa of the pelvis. The remainder of the kidney showed destruction by cloudy swell-

ing. The left kidney showed characteristic cloudy swelling. The blood vessels were dilated and full of blood. No evidences of pyogenic infection.

Dog 13. Both ureters were transplanted October 9, 1929. The non-protein nitrogen taken at the time of operation was 35 milligrams. Urine cultures from both sides were sterile. Following operation the dog failed to eat and showed a progressive downward course. Catheters came away on the third and fourth postoperative days. On the fourteenth postoperative day the non-protein nitrogen was 138 milligrams and on the twenty-first postoperative day the non-protein nitrogen was 113 milligrams. Death occurred on the thirty-first postoperative day.

At autopsy the operative wound was well healed. The peritoneum was smooth and glistening. The right kidney and ureter were normal in size. The left kidney and ureter were slightly dilated. The left ureter showed two kinks due to adhesions. Both anastomoses showed that the sutures in the muscularis had pulled out so that the mucosa of the sigmoid was exposed and no valve action obtained. Catheters passed down both ureters entered the bowel, but there was a slight stenosis of the left ureterosigmoidal opening. On gross section both kidneys were seen to contain pus.

Microscopic sections showed small abscesses throughout the cortex. In several areas the capsular spaces showed an accumulation of albuminous material. The left kidney appeared as did the right.

Dog 14. Both ureters were transplanted October 11, 1929. Following operation, the dog showed a progressive downward course. One catheter came away in 12 hours, and the second catheter came away after 2 days. Eighteen days after operation the non-protein nitrogen was 146 milligrams. Death occurred October 30, 19 days after operation, at which time the dog was markedly emaciated and showed a bilateral purulent conjunctivitis.

At autopsy the peritoneum was smooth and glistening. There were a few adhesions around the urinary bladder. Both anastomoses were well healed, and the left kidney and ureter were normal in size. The right kidney was somewhat smaller, and the right ureter was not dilated. A catheter passed down the left ureter entered the sigmoid without obstruction. A catheter passed down the right ureter would not enter the sigmoid, as the ureterosigmoidal opening was covered over by mucosa of the bowel.

Microscopic sections of the right kidney showed a diffuse acute inflammatory reaction in the cortex. There were many small abscesses in the mucosa and submucosa of the pelvis. The left kidney showed only one area in which there was an inflammatory reaction, and this was around a fibrous glomerulus.

Dog 21. Both ureters were transplanted December 2, 1929. After operation the dog showed a progressive downward course. Both catheters came out on the twelfth day, and death occurred on the seventeenth postoperative day.

At autopsy a small superficial abscess was found in the operative wound. The peritoneum, however, was smooth and glistening. The right kidney was somewhat smaller than the left, and the lower pole showed an area of dark discoloration. The ureter was not dilated. On gross section free pus was found in the pelvis, but the cortical and medullary markings were normal. There were infarcts in the upper and lower poles. The right anastomosis was normal, and a catheter passed down the ureter entered the bowel without obstruction. The left kidney was slightly larger than the right, and the pelvis contained frank pus. The cortical and medullary markings were distinct, and the pelvis was not dilated. The left ureter was normal in size and patent throughout. The left anastomosis was well healed.

Microscopic sections of the right kidney showed no evidence of pyogenic infection. The left kidney showed a cellular infiltration beneath the mucosa of the pelvis and polymorphonuclear leucocytes were seen scattered through the cortex. Some of the glomeruli were replaced by fibrous tissue. Both kidneys showed marked evidence of cloudy swelling.

Dog 22. Both ureters were transplanted December 9, 1929. The postoperative non-protein nitrogen was 40 milligrams, and cultures of the urine taken at the time of operation were sterile. Both catheters came out on the fifth day. The dog showed a progressive downward course after operation. Shortly before death the non-protein nitrogen was 98 milligrams. The dog was killed on the tenth postoperative day because of poor general condition.

At autopsy the operative wound was slightly infected. The peritoneum, however, was smooth and glistening, and there were no adhesions in the abdomen. The right kidney was about three times normal size and quite dark in color. The right ureter was also dilated. The left kidney and ureter were slightly larger than normal. On gross section the parenchyma of the right kidney was soft and hæmorrhagic throughout, and the cortical and medullary markings were obliterated. The pelvis was dilated and full of pus. The right anastomosis was well healed, and a catheter passed down the ureter entered the bowel without obstruction. On gross section the left kidney showed normal markings, and the pelvis was not dilated but contained frank pus. The left anastomosis was well healed. A catheter passed down the left ureter entered the bowel without obstruction. The intrasigmoidal portion of the left ureter had not sloughed off.

Microscopic sections of the right kidney showed a diffuse cellular infiltration, with abscess formation in the cortex. The left kidney showed a generalized inflammatory reaction but no abscesses.

Dog 24. Both ureters were transplanted December 16, 1929. Following operation the dog showed marked loss of weight and refused to eat. Both catheters came away on the fifth day. Urine cultures taken at the time of operation were sterile, and the non-protein nitrogen was 27 milligrams. The animal died 10 days after operation.

At autopsy the operative wound showed a small abscess. The peritoneum, however, was smooth and

glistening. There were no adhesions in the abdomen. The left kidney was enlarged about three times normal size and was soft and fluctuant. On section a large amount of turbid urine escaped, and the pelvis seemed to be markedly dilated. The cortex of the left kidney was quite thin, but the markings were distinct. The left ureter was correspondingly dilated. The right kidney was enlarged about twice the normal size and on section was found to contain a large amount of yellowish purulent material. The cortical markings were indistinct, and the pelvis was dilated and showed an exudate on its surface. The right anastomosis was well healed. The left anastomosis showed infection in the lower portion. Both ureterosigmoidal openings were stenosed, so that No. 6 catheters were passed with difficulty.

Microscopic sections of both kidneys showed extensive infection throughout. Much hæmorrhage and a few infarcts were found beneath the capsule.

In 4 dogs of the above group, dogs 13, 14, 22, and 24, we were able to demonstrate histological evidence of bilateral renal infection. Three dogs, 10, 12, and 21, showed infection in only one side, and in one animal, dog 9, we were unable to find microscopic evidence of pyogenic infection. However, dog 9 showed a large hydronephrosis with parenchymal degeneration.

Complete closure of the ureterosigmoidal opening occurred in only one ureter, dog 14, and in this animal one catheter was pulled out a few hours after operation. The 2 cases, dogs 13 and 24, in which the ureteral openings were stenosed, showed an extensive infection in both kidneys. A completely normal kidney was not seen in the entire group, although five kidneys failed to show microscopic evidence of pyogenic infection.

COFFEY TECHNIQUE; ONE URETER TRANSPLANTED

In two dogs, numbers 15 and 16, a single ureter was transplanted by the Coffey technique. The results in these two operations were better than we had obtained in any of the groups thus far studied. The dogs lived for 76 and 87 days, and at autopsy there was no macroscopic evidence of disease in the urinary tract. Microscopic study showed no evidence of pyogenic infection. Apparently these were successful transplants, but the dogs did not ever appear well after being operated upon.

Dog 15. The right ureter was transplanted October 30, 1929. The catheter came out on the second day. The dog refused to eat for 2 weeks before death. She had appeared well up until that time except for loss of weight. Death occurred January 14, 1930, 76 days after operation.

At autopsy the peritoneum was smooth and glistening. There were a few adhesions around the bladder. Both kidneys were of the same size and color. On gross section the right kidney showed no evidence of infection. The right ureter was of normal size, and a catheter passed down the ureter entered the bowel without obstruction. The anastomosis was in good condition.

On microscopic section there was no inflammatory reaction in either kidney. Both kidneys showed some cloudy swelling.

Dog 16. The right ureter was transplanted November 6, 1929. The catheter came out on the thirteenth day. The animal never appeared quite normal after the operation and steadily lost weight. About 1 month after operation she contracted mange, for which she had to be killed February 5, 1930, 87 days after operation.

Ether anæsthesia was started, but the dog promptly died. There were no signs of peritonitis. The kidneys were of equal size and color. The transplanted ureter was not dilated, and a catheter passed down it entered the bowel without obstruction. The anastomosis was in excellent condition. On gross section there was practically no difference between the transplanted and the untransplanted sides.

On microscopic section there was no inflammatory reaction in either kidney. Both kidneys showed some cloudy swelling.

In comparing the results of the Mayo and Coffey operations in dogs, some difference is noted in so far as infection is concerned. The microscopic sections of the kidneys operated upon by the Coffey technique showed less evidence of pyogenic infection, but the dogs were all definitely sick after transplantation was done. Obviously the best results were obtained by the Coffey technique, in which only one ureter was transplanted. The troublesome ureteral stenosis so often mentioned by workers in this field seems to be largely obviated by the use of the ureteral catheters.

The high incidence of postoperative renal infections led to considerable speculation as to the manner in which the kidney becomes involved. Close observation of a recent clinical case suggested to us that infection may reach the kidney by means other than the lumen of the ureter, as shown in the following case:

A boy, aged 10 years, was admitted to the hospital November 7, 1929, with exstrophy of the urinary

bladder. Pre-operative studies showed an uninfected urinary tract and the non-protein nitrogen was 35.6 milligrams. He was operated upon December 3, 1929, and both ureters were implanted in the sigmoid by the Coffey tube technique. No. 8 ureteral catheters were used and urine drained well during and after the operation. The ends of the catheters were placed in sterile bottles covered with sterile corks. Each time the bottles were emptied, fresh sterile bottles were used. The immediate postoperative convalescence was uneventful except for marked abdominal distention, which was finally relieved by irrigation through a rectal tube. Four days after operation urine from the right and left catheters showed 1 to 3 pus cells per field. Seven days after operation urine from the right catheter showed 1 to 3 pus cells per field, and urine from the left catheter showed 15 to 30 pus cells per field. Nine days after operation the right side showed 5 to 10 pus cells per field and the left 20 to 40. Eleven days after operation both sides showed pus cells too numerous to count, and culture of the urine showed streptococci and bacillus coli. The left catheter came out 11 days and the right catheter came out 17 days after operation. Shortly before the catheters came away, the non-protein nitrogen was 33 milligrams, and 3 days after the last catheter came out the non-protein nitrogen was 65.6. Three days later it had dropped to 34 milligrams. About 48 hours after the second catheter came away, the patient developed a sharp rise in temperature, which reached 105 degrees. At the same time localized tenderness was noted in the left costovertebral angle, which persisted for several days. After 4 days the temperature returned to normal and remained there. The patient's recovery was delayed by a low-grade wound infection. He was discharged January 26, 1930, at which time he could retain his urine for as long as 6 hours. His general condition was excellent, and a letter from his mother April 10, 1930, says that he is now enjoying excellent health. He is to return in a few months for removal of the bladder.

The beginning and the progressive increase of the infection while the catheters were in place and amply protected, we believe, offers a strong argument against renal infection ascending the lumen of the ureter in this case.

TRANSPLANTATION OF LIGATED URETERS

In an attempt to study the question of renal infection, four groups of experiments were done on 8 dogs.

The right ureters were doubly ligated with linen in the first group, dogs 17 and 18, and the ureters transplanted by the Mayo technique. Urine collected from the right kidneys at the time of operation was sterile. Complete records of the 2 dogs in group 1 follow:

Dog 17 was operated upon November 8, 1929, and she was anæsthetized for study 7 days later. There was no peritonitis but a few adhesions were found in the region of the anastomosis. The right ureter was dilated to about three times the normal size. On pulling aside the gut, a large amount of free pus was found in the right perirenal area. Culture of this pus showed streptococci. The left kidney and ureter appeared normal. Urine from the right kidney showed bacillus coli and many pus cells. The dog was then killed with chloroform, and the upper pole of the right kidney was found to be adherent to the liver. The right kidney was three times the size of the left, was dark in color, and showed a large number of engorged vessels over the surface. On gross section the left kidney appeared entirely normal. On gross section the right kidney showed a marked thickening of both the cortex and medulla, with a loss of all normal markings. At the lower pole was a subcortical abscess about 4 centimeters in diameter, and in the upper pole there was another subcortical abscess about 2 centimeters in diameter. A No. 4 catheter passed down the right ureter entered the sigmoid without obstruction.

Microscopic sections of the right kidney showed an extensive inflammatory exudate throughout the substance of the kidney. The left kidney showed the changes of cloudy swelling. There was no evidence of pyogenic infection.

Dog 18 was operated upon November 22, 1929, and anæsthetized for study 3 days later. There was a localized abscess at the site of the previous incision. The pelvic peritoneum was inflamed, and there was a suppurative process at the site of the anastomosis with many adhesions in this area. Urine taken from the right kidney showed bacillus coli. The dog was then killed with chloroform. The right kidney was slightly larger than the left, but the ureter was normal in size. The left kidney appeared entirely normal. A catheter passed down the right ureter did not enter the sigmoid, as the ureter was still firmly ligated. The sutures at the site of anastomosis had sloughed out and free pus was found in this area. On gross section the right kidney showed a reddish discoloration of the medulla and cortex, although the parenchymal markings were distinct. There was a slight hydronephrosis, and the pelvis contained macroscopic pus.

Microscopic sections of the right kidney showed an acute inflammatory reaction in the pelvis, with abscess formation beneath the mucosa. The left kidney showed no evidence of pyogenic infection.

Right renal infection was demonstrated in both dogs of this group. In one, dog 17, the ureter was patent and no opinion can be given as to the manner in which the kidney became infected. However, in dog 18 the ureter was still firmly ligated, which would indicate that the lumen of the ureter could not have transmitted the infection.

In the second group, dogs 19 and 20, of these experimental operations, we made an effort to protect the end of the ureter. In this group the right ureter was doubly ligated with linen and a small opening was made in the mucosa as for a transplant so that the end of the ureter was potentially infected. This opening in the mucosa was then closed with fine catgut and the ureter implanted between the mucosal and muscular layers of the sigmoid. Urine from the right kidney was sterile in each case. The complete records of the 2 dogs in group 2 are given below.

Dog 19 was operated upon November 25, 1929, and was anæsthetized for study 8 days later. The operative wound showed a low-grade infection, but the peritoneum was normal. There were a few adhesions in the region of the anastomosis. Culture obtained from the right kidney showed diphtheroid bacilli. The right kidney was slightly larger than the left and showed many engorged vessels over its surface. The right ureter did not appear dilated. On cut section the right kidney showed normal markings, but the pelvis was slightly dilated. There was no gross evidence of infection. A No. 14 catheter passed down the right ureter entered the bowel without obstruction.

Microscopic sections of the right and left kidneys showed no evidence of pyogenic infection. There was some destruction in the tubular epithelium due to cloudy swelling.

Dog 20 was operated upon November 29, 1929, and anæsthetized for study 8 days later. There was a low-grade wound infection. The abdominal cavity was clean. There was a mass of adhesions in the lower abdomen in the area of anastomosis. Urine obtained from the right kidney for culture showed bacillus coli and streptococci. The right kidney was normal in size but was soft and fluctuant throughout. On gross section the right kidney showed clear urine in the pelvis, which was not dilated. The parenchyma was normal in color and thickness. The markings were distinct. The ureter was of uniform thickness and not dilated. A catheter passed down the right ureter entered the bowel without obstruction.

Microscopic sections of the right kidney showed small areas of cellular infiltration beneath the submucosa of the pelvis. The left kidney showed no inflammatory changes.

In both animals of group 2 the patency of the ureter was found to have been reestablished at the time of autopsy. Neither kidney was infected in dog 19, and in dog 20 the right kidney was only mildly infected as shown by the microscopic slides. Better kidneys were found in group 2, dogs 19 and 20, than in group 1, dogs 17 and 18. We attributed this fact to the delayed exposure of the end of the ureter to infected bowel contents. Again we believed we had obtained results which indicated that the lumen of the ureter was not the transporting agent for renal infection in these cases.

In group 3, dog 25, the right ureter was ligated and transplanted between the mucosa and muscularis without making an opening in the mucosa. Urine taken from the right kidney at the time of operation was sterile. Even though the end of the ureter was ligated and not exposed to infectious material, the right kidney showed a marked inflammatory reaction after 9 days. The complete record of dog 25 is given below.

Dog 25 was operated upon December 18, 1929, and anæsthetized for study 9 days later. The peritoneum was normal. The right kidney was twice the size of the left and showed many large veins over its surface. Culture obtained from the right kidney showed staphylococci. On section, thin bloody fluid escaped from the pelvis. The parenchyma was of normal thickness, and the markings were distinct. The right ureter was twice the size of the left. The anastomosis was well healed. A catheter passed down the right ureter failed to demonstrate an opening in the mucosa.

Microscopic sections of the right kidney showed a heavy leucocytic infiltration throughout. There was a great deal of hæmorrhage. The left kidney showed no evidence of pyogenic infection, but the epithelium of the tubules was destroyed by cloudy swelling.

The tendency for the re-establishment of drainage in groups 1 and 2 of these experimental operations suggested to us that we might decrease the period of obstruction in the ureter and obtain even better results. So in group 4, dogs 27, 28, and 29, the right ureter was ligated with No. 1 plain catgut and transplanted by the Mayo technique. In each case sterile urine was obtained at operation. These dogs were allowed to live 15, 23, and 25 days so that the pathological changes, if any, would be well developed. The complete records of group 4 are given below.

Dog 27 was operated upon February 24, 1930. The postoperative course was uneventful except for some loss of weight. The animal was anæsthetized 15 days after operation and urine obtained from the right kidney for culture showed streptococci and bacillus coli. The peritoneum was smooth and glistening throughout. There were a few adhesions in

the region of the anastomosis. There was a small localized abscess in the retroperitoneal area at the site where it had been opened to liberate the ureter at the time of the original operation. The right kidney was slightly larger than the left; otherwise they both appeared normal. The right ureter was twice the size of the left. On section the right kidney showed no gross pathological changes. A catheter passed down the right ureter entered the sigmoid without difficulty. There was a small abscess in the wall of the sigmoid where it had been penetrated by the retention suture.

Microscopic sections of the right kidney showed a few small areas of cellular infiltration near the pelvis, otherwise the kidney showed only the changes of cloudy swelling. The left kidney showed a marked inflammatory reaction with abscesses throughout the cortex.

Dog 28 was operated upon February 27, 1930, and the postoperative course was normal. She was anæsthetized for study 25 days after operation. The abdominal cavity was clean. The large bowel was slightly adherent to the bladder. The anastomosis was well healed, and urine obtained from the right kidney showed staphylococci, which was thought to be a contamination, as the microscopic examination of urine showed only a very occasional pus cell. Grossly, the right kidney showed no changes from the left. A catheter passed down the right ureter entered the bowel without obstruction.

Microscopic sections of the right and left kidneys showed no evidence of inflammatory reaction. The changes of cloudy swelling were present in both.

Dog 29 was operated upon March 3, 1930, and the postoperative convalescence was uneventful. The animal was anæsthetized for study 23 days after operation. There was a slight wound infection, but the peritoneum was smooth and glistening. There were a few adhesions in the area of anastomosis. The right kidney appeared smaller than the left. Urine obtained from the right kidney for culture was sterile. On gross section the right kidney showed a few areas of ecchymosis in the cortex and medulla. The pelvis was of normal size. A catheter passed down the right ureter entered the bowel without obstruction.

Microscopic sections of the right kidney showed a marked inflammatory reaction throughout, with abscess formation. The left kidney showed a cellular infiltration beneath the mucosa of the pelvis.

In all 3 cases of group 4, the right ureter was patent throughout at autopsy. Two dogs, 27 and 29, developed a bilateral renal infection, and only one, dog 28, showed uninfected kidneys on microscopic examination. The results in this group were indicative of the value of protection to the end of the ureter and the possibility of using some type of obstruction to obtain this protection.

SUMMARY

In our hands the transplantation of the ureters to the sigmoid in dogs is highly unsatisfactory by the Mayo technique. In every case the kidney became infected and closure of the ureterosigmoidal opening by the mucosa of the bowel occurred in 5 of the 7 unilateral transplants. In the 2 bilateral transplants the ureteral openings were markedly stenosed.

The completed Coffey technique gave slightly better results. Of the 8 dogs, 4 showed bilateral infection, 3 showed infection in only one side, and 1 showed no evidence of infection but was hydronephrotic on one side. Complete closure of the ureteral opening occurred in only one ureter.

The unilateral Coffey operations revealed kidneys in which there was no microscopic evidence of pyogenic infection, yet the dogs never appeared well after operation.

Believing that the kidneys became infected by means other than the lumen of the ureter, we obtained infected kidneys in 2 cases in which the ureters were still completely obstructed at autopsy. The lymphatics must be given serious consideration as a means of transmitting infection to the kidneys. A clinical case showed the infection to begin while the catheters were still in the lumen of the ureters. The excellent work of Sweet and Stewart describes the lymphatic route.

Solution of the problem of preventing ascending renal infection probably depends upon the discovery of means to prevent infection through the lymphatics. Partial success in this direction was obtained in our experimental cases in which we tried to protect the exposed end of the ureter for a time from infected material. These results suggest that a new technique for transplantation with this principle in view might lessen the tendency to renal infection.

Both Coffey and Kirwin have recently described new techniques whereby the end of the transplanted ureter is protected. In a personal communication Coffey states that his results in dogs with this new technique indicate that it may supersede his tube technique when single ureters are transplanted.

Until a uniformly successful procedure is evolved, it would seem the better surgical

judgment to use ureteral transplantation only in those cases in which older and better understood methods are impossible.

REFERENCES

1. Coffey, R. C. Transplantation of the ureters into the large intestine. Surg., Gynec. & Obst., 1928, xlvii, 593–621.
2. Idem. Bilateral submucous transplantation of ureters into large intestine by tube technique. Clinical report of twenty cases. J. Am. M. Ass., 1929, xciii, 1529–1538.
3. Idem. Experimental transplantation of ureter in which a transfixion suture is used to complete the anastamosis. Northwest Med., 1930, xxix, 128.
4. Idem. Personal communication.
5. Fifield, L. R. Primary neoplasms of the urinary bladder. London: H. K. Lewis & Co., 1928.
6. Kirwin, G. J. A study of ureteral transplantation. Am. J. Surg., 1930, viii, 1–27.
7. McKenna, C. M. Transplantation of the ureter. J. Urol., 1928, xix, 527–540.
8. Mayo, C. H., and Walters, W. Transplantation of ureters into rectum. J. Am. M. Ass., 1924, lxxxii, 624–626.
9. Sweet, J. E., and Stewart, L. F. The ascending infection of the kidneys. Surg., Gynec. & Obst., 1914, xviii, 460–469.
10. Turner, G. G. The treatment of congenital defects of the bladder and urethra by transplantation of the ureters into the bowel; with a record of 17 personal cases. Brit. J. Surg., 1929, xvii, 114–178.

CONCERNING THE ETIOLOGY OF HYPERPLASIA OF THE ENDOMETRIUM

J. HOFBAUER, M.D., F.A.C.S., Baltimore, Maryland
From the Department of Obstetrics, Johns Hopkins University and Hospital

In the realm of pathological endometrial conditions, hyperplasia of the endometrium, owing to its frequency as well as to its relation to functional uterine hæmorrhage, occupies a singular position. The study of this histological and clinical entity has been the subject of numerous investigations ever since Olshausen in 1878 focused the attention of gynecologists on the correlation between long continued uterine hæmorrhages with a conspicuous thickening of the endometrium, which he described in detail and designated as endometritis fungosa or chronic hyperplastic endometritis. The subsequent researches of German authors (Franz, Buettner, Seitz, Schroeder, R. Meyer), as well as the recent studies of Shaw in England, and notably the work of Cullen, Novak and Martzloff in this country, have been of importance in establishing the anatomical findings in the condition of the endometrium under consideration.

The nature of hyperplasia of the endometrium is that of an overgrowth of its constituents, both epithelial elements and stroma. The endometrial overgrowth is evident on gross examination, which reveals a definitely thickened mucosa, occasionally as much as a centimeter and a half in diameter. When the process is pronounced, the endometrium is thrown into folds which may form polypoidal protrusions into the uterine cavity, the condition then being called polypoid endometrial hypertrophy. The proliferative activity of the epithelial elements, as well as of the stroma constitutes the characteristic feature of a more or less distinctive histological picture, with slight individual variations in certain instances. The stroma is excessive in amount and shows an abundance of cellular elements. It may be dense or somewhat œdematous, the latter being particularly noticeable in the proximity of areas of disintegration. The blood vessels are often distended and there may be extravasation of blood into the superficial layer of the mucosa beneath the epithelium. Here and there a thrombosed vessel may be seen. Hyperæmia of the entire endometrium is essentially due to a marked dilatation of the capillaries. On the other hand, the most specific histological feature of hyperplasia of the endometrium consists in the characteristic gland pattern. The glands are increased in number, and in places are thickly crowded together; some of them are small, while the majority appear enlarged. The glands are lengthened and have assumed a

tortuous appearance. Sometimes they branch, but they never invade the muscle wall of the uterus. Dilatation of the glands occurs quite commonly, cystically dilated glands being found chiefly in the middle zone of the endometrium. Novak, and recently Schroeder and Shaw also, attach great importance to this phenomenon, claiming that the "Swiss cheese pattern" of the endometrium should be considered a significant feature of the condition in question. The glandular epithelium is of the high columnar type with no suggestion of secretory activity. At times it presents a double row of elements, which occasionally may resemble the conditions found in the beginning of an adenocarcinoma. When the glands have become markedly distended, the lining epithelium is correspondingly flattened out. A lymphocytic infiltration of the superficial layer of the endometrium is sometimes noticeable in the small areas of disintegration.

For years, hyperplasia of the endometrium has been correlated with ovarian disorder, the true nature of which was obscure. Since recurrence of hyperplasia is frequently noted after repeated curettage, persistence of ovarian dysfunction has been invoked to account for the clinical observation. Small cystic follicular atresia with absence of lutein tissue is said by Schroeder to be the characteristic finding, and he regards the anatomical changes in the uterus as secondary to the ovarian pathology. Hence, the terms ovariopathia hæmorrhagica or hyperplasia endometrii ovarialis were suggested by him in order to cover both the clinical and anatomical features of the condition. Schroeder argues that the primary phenomenon consists in an increased number of maturing follicles, the great majority of which deteriorate and form small cysts. It is the persistence of a prolonged period of maturation of follicles which, according to his reasoning, characterizes the abnormal ovarian activity, and in turn accounts for the pathological proliferation of the endometrial constituents—connective tissue and epithelium. Owing to the fact that atresia of follicles is attended with a certain amount of secretion, small cysts may develop in the course of time. However, what causes the cystic degeneration of the ovaries is at present still a matter of mere speculation. Disturbances of circulation, such as repeated or continuous hyperæmia, with or without inflammatory processes are considered by some writers to be at the basis of the problem. Beyond the demonstration that hyperplasia of the endometrium may follow repeated abortions, or pelvic inflammation, or uterine misplacements, there is no definite proof of an interrelationship between prolonged hyperæmia or passive congestion of the genital organs on one hand and cystic degeneration of the ovary on the other. There have been indications of late that hyperplasia of the endometrium may be associated with granulosa cell tumor of the ovary or may result from non-gratified sexual desire.

Because of our present defective knowledge of the actual cause of hyperplasia of the endometrium, an endocrine disorder affecting the ovary primarily or secondarily has been considered by some investigators. Novak writes: "In view of the probability of hyperplasia being an anatomical expression of an endocrine disorder, it was of interest to search for endocrine symptoms in our patients. In no case was any note made of thyroid symptoms, either of hypothyroidism or hyperthyroidism." Shaw remarks: "It is difficult to believe that the stimulus is exerted by the ovaries, for the latter are relatively inactive. The uterine hyperplasia is controlled by some other factor reaching the uterus independently of the ovaries." Yet, no definite interdependence of any endocrine factor with the causation of either cystic ovaries or anatomical changes in the uterine mucosa has hitherto been demonstrated.

There is no denying the dictum that an accurate knowledge of the normal occurrences constitutes the first prerequisite for a proper understanding of pathological phenomena. With reference to the determination of the cause of the hyperplastic changes in the uterine mucosa, the physiology of the cyclic changes which occur in this structure may reasonably be regarded as providing the basis for the elucidation of the problem under consideration. In this connection it should be remembered that the doctrine of the "primacy of the ovum" in the causation of the cyclic

changes of the uterine mucosa, as well as in the regulation of menstrual periodicity has held sway for a long period of time. In a paper read abroad before a gynecological society in 1923, the writer pointed out that the bulk of evidence obtained both by experimental study and clinical observation strongly suggests that the regulation of ovarian periodicity and of menstrual rhythm is controlled by the anterior lobe of the pituitary and a correlated hypothalamic center. Without going into the details, it will suffice to indicate here the principal points: A subtle reciprocal relationship between the anterior pituitary and the ovarian follicles can be established by showing that the follicular fluid acts as a stimulus on the pituitary, which in turn initiates and promotes the ripening of follicles. In the light of these views, the cyclic endocrine activity of the two organs may be brought into consonance, and an acceptable explanation may be offered for the occurrence of rhythmical changes in the uterine mucosa. Zondek, in a recent paper, fully corroborates this conception.

With this phase of our knowledge of sex physiology established, the next obvious step was to learn whether it would be possible to produce in experimental animals an exaggeration of the proliferative phenomena which normally occur in the uterine mucosa during pro-oestrum by the daily administration of pituitary substance over a prolonged period of time. Guinea pigs were chosen for these experiments since accurate data concerning the structure of the mucosa in the various stages of the cycle in this species have been established by the exhaustive studies of Stockard. Furthermore, the similarity in structure of the endometrium in that animal and in woman, made it appear possible that results obtained in the one might be transferred to the other without too great stretch of the imagination.

The growth-promoting principle of the anterior lobe obtained from alkaline extracts of pituitary glands of beef prepared according to Evans' method has been used in the majority of the experiments, while a few animals were treated with acid extracts of the gland. In a third series of experiments bits of fresh anterior lobe were transplanted into the musculature of the thigh.[1] The extracts were injected intraperitoneally for 12 successive days, 1 cubic centimeter being the standard dose, while two transplantations were made during the course of 19 days. The animals were sacrificed on the thirteenth day in the former group and on the twentieth day in the latter.

Upon gross examination, the most noticeable feature in the uterus consisted in a considerable increase in circumference attended with a purple-bluish discoloration. Another change consisted in the readiness of the uterus to contract, as manifested by the occurrence of peristaltic contractions which persisted after the animals had been killed. Of first importance among the data obtained on microscopic study of the thickened uterine mucosa is the fact that a striking increase of the connective tissue has taken place, its elements appearing definitely enlarged and at the same time more abundant. While this phenomenon is obvious in the entire mucosa, the increase of the interstitial tissue is most pronounced in its basal layer, which is considerably augmented in height and also in density. In the upper two-thirds of the mucosa the glands are conspicuous by their great number. Their active proliferation is readily recognizable, as they have become greatly lengthened, more tortuous and occasionally branching. Cystic dilatation of the glands may be distinguished here and there in the middle layer of the mucosa. This occurred in quite a number of instances in the first group, but was most marked in animals which were treated by the method of transplantation. The histological findings may be best demonstrated by photomicrographs, when it will be seen that Figure 3 bears a close resemblance to the "Swiss cheese pattern" of hyperplastic endometrium, as depicted by Novak.

The epithelium of the glands is of the high columnar type with no indication of secretion whatsoever. When the glands have become dilated the epithelium may be seen flattened. Extensive dilatation and engorgement of capillaries and also of vessels of a larger caliber are seen both in the uterine wall and in the

[1] Twenty-four animals were treated with the alkaline extract, 4 with the acid extract; while transplantations were made in 18 additional animals.

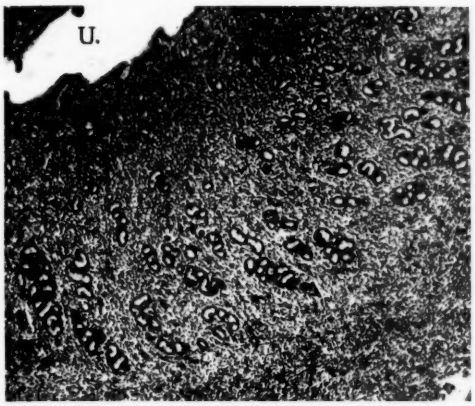


Fig. 1. Photomicrograph showing conditions of uterine mucosa of guinea pig which had been injected for 12 days with alkaline extract of beef's anterior lobe. Note increase in connective tissue, lengthening of glands. *U*, uterine cavity. ×40.

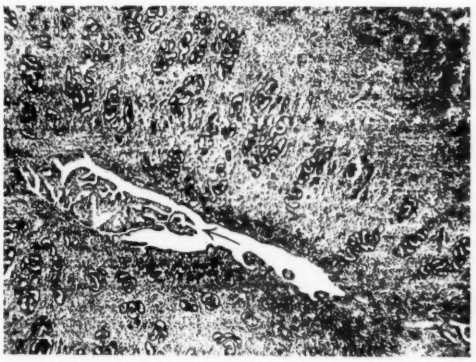


Fig. 2. Photomicrograph of uterine mucosa of another specimen after similar treatment. Note formation of polypus, to which arrow points; also dark area of disintegration beneath the uterine epithelium with lymphocytic infiltration. ×33.

mucosa. Discrete patches of extravasated blood may occur in the uppermost layer of the latter, independent of, or associated with, small areas of disintegration. Lymphocytic infiltration of the superficial zone of the uterine mucosa along with intense hyperæmia was a noticeable feature in a few specimens obtained from animals which had been injected with alkaline extracts immediately following abortion, and for 12 more days in succession. Formation of polypoid excrescences of the uterine mucosa may also occur under these conditions, as seen in Figure 2. Figure 4 exemplifies the condition of the uterine mucosa of a normal guinea pig (control).

The peculiar response of the ovaries to the administration of anterior pituitary is shown by reference to photomicrograph Figure 5. In general, it may be said that in marked contrast to the findings in the mouse, there is very slight, if any, enlargement of the ovary. In addition, while the condition of the ovary of the mouse is characterized by a marked hyperæmia and the occurrence of blood-spots ("blutpunkte"), in our series of experiments only a moderate congestion of the ovarian tissue may be seen upon histological examination. Moreover, there is no overproduction of lutein tissue; indeed, in the implanted animals luteinization is rather insignificant.

The essential point in the ovarian picture after prolonged treatment or massive dosage of pituitary is seen in the occurrence of many cystic follicles with the granulosa persisting. This overproduction of atretic follicles strikingly resembles the phenomena found in "small cystic follicle atresia of the ovary," which occurs under certain gynecological conditions in women. Similar formations are known to obtain in the ovary during pregnancy, as well as in the ovary of the newborn. Smith and Engle in 1927 first described the formation of small follicular cysts in the

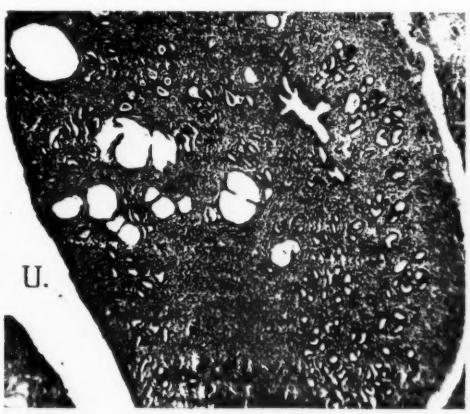


Fig. 3. Photomicrograph of uterine mucosa obtained from guinea pig which had been transplanted twice with anterior lobe, showing "Swiss cheese pattern." ×33.

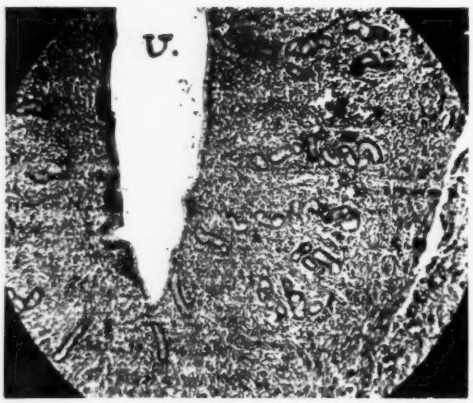


Fig. 4. Photomicrograph of uterine mucosa of untreated guinea pig (control). ×45.

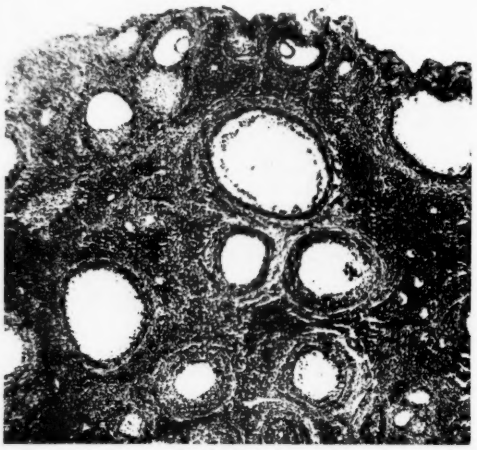


Fig. 5. Photomicrograph of ovary obtained from guinea pig which had been transplanted twice with beef's anterior lobe. Note numerous atretic follicles. ×45.

ovary of the rat after the repeated implantation of anterior pituitary.

The presentation of the pathological physiology of the uterine mucosa attendant upon the parenteral administration of anterior lobe of pituitary would be incomplete without considering the ovarian factor which affects the complex mechanism determining the uterine phenomena. In other words, in view of the protective influence of ovarian elements, follicle and corpus luteum, known to be far reaching on the function and cyclic changes peculiar to the uterine mucosa, it was deemed necessary to study the effect of the administration of anterior pituitary to spayed animals. It is particularly with this aspect of the question in mind that a few experiments have been conducted on guinea pigs which had been ovariectomized, and after a lapse of 2 weeks were subjected to the repeated injection of alkaline extracts or to transplantation of anterior pituitary. It seems permissible to conclude that whatever changes can be demonstrated upon microscopic study of such uteri must be attributed to the action of the anterior lobe of the pituitary gland and to it alone.

As an invariable feature, marked congestion of the uterus could be ascertained grossly, but distention and the tendency to contract were absent. Turning to the conditions found on microscopic study, the principle point which concerns us here is the slight thickness of the mucosa as compared with the specimens described above; there being no increase on the part of either the epithelium or interstitial tissue elements. There occurs, however, a definite, if slight thickening of the connective tissue in the basal layer of the mucosa which surrounds and supports the fundi of the glands. The epithelium of the fundi of the glands stains deeply, while in the upper part of the glands it displays less affinity to staining. To a slight extent dilatation of glands may be encountered in the superficial layer of the mucosa. Appreciable engorgement of the vessels obtains only in the muscle layer and also in the lowest part of the mucosa. Thus, it is apparent that following bilateral ovariectomy the reaction of the uterine mucosa to anterior pituitary is limited to the basalis, and does not involve the entire thickness of the structure, as in the experiments mentioned.

SUMMARY AND CONCLUSIONS

The etiology of hyperplasia of the endometrium presents a problem which is still inadequately understood. Several writers have recently expressed the view that in all probability an unrecognized endocrine factor is concerned in the etiology of this condition.[1]

[1] In view of the present inadequate knowledge of the nature of hormones in the blood and in the urine great caution should be exercised in drawing conclusions from positive or negative findings in them.

Our investigations have shown that in guinea pigs treated parenterally with derivatives of the anterior pituitary, conditions may be produced in the uterine mucosa, as well as in the ovaries, which are practically identical with those observed in endometrial hyperplasia in women. This obtained so long as the ovaries were preserved, but when they had been removed, the process was limited to the basal portion of the endometrium. Our observations suggest the view that *hyperplasia may reasonably be regarded as the manifestation of an overactivity of the anterior pituitary lobe.* This conclusion, that an outside factor represents the primary cause of the disease is corroborated by the clinical experience that the condition commonly recurs after repeated curettage. If we accept this new conception concerning the etiology of hyperplasia of the endometrium, the application of X-rays to the pituitary with the view of suppressing its excessive activity enters upon a new phase. This method was introduced into the gynecological armamentarium for the relief of various conditions by the writer in 1922, and is now widely used not only on the continent but also in this country, mainly in the Mayo Clinic.

These studies have an obvious bearing upon the question as to whether the anterior lobe of the pituitary registers its effect on the uterine mucosa directly or through the agency of the ovary. Before we proceed to the answer of this question, it appears desirable to emphasize that at the present time the view advanced by Corner and Allen is preponderant. They consider that the release of a certain supply of follicular hormone initiates the cyclic uterine phenomena, which subsequently culminate in the formation of pregestational changes as a response to additional hormonic influences derived from the corpus luteum. Furthermore, they hold that the integrity of the entire endometrium depends upon the influence of the ovarian hormone. Our observations, however, indicate that the internal secretion of the ovary is essential for the changes occurring in the upper part of the uterine mucosa—the "functionalis," while the basal layer is under the control of the anterior pituitary lobe, as judged by the response of this structure to repeated pituitary administration in ovariectomized animals.

REFERENCES

1. Buettner. Arch. f. Gynaek., 1910, xcii, 781.
2. Corner and Allen. Am. J. Physiol., 1930, xcii.
3. Cullen. Canadian M. Ass. J., 1913, iii, 658.
4. Hofbauer. Zentralbl. f. Gynaek., 1924, No. 3; Arch. f. Gynaek., cxvii, cxx.
5. Meyer, R. Arch. f. Gynaek., 1920, cxiii, 259.
6. Novak and Martzloff. Tr. Am. Gynec. Soc., 1924.
7. Olshausen. Arch. f. Gynaek., 1878, viii.
8. Schroeder. Monograph in Veit-Stoeckel's Handbuch der Gynaecologie, 1929, vol. iv.
9. Seitz. Ztschr. f. Geburtsh. u. Gynaek., 1921, lxxxiii, 666.
10. Shaw. J. Obst. & Gynæc, Brit. Emp., 1929, xxxvi.
11. Smith and Engle. Am. J. Anat., xl, 173.
12. Zondek. Klin. Wchnschr., 1930, No. 6.

FOLLICULAR DESTRUCTION IN THE NORMAL THYROID OF THE DOG

With a Consideration of the Relation Between Follicles and Interfollicular Cells

GUSTAV ZECHEL, M.D., Chicago
Associate in Anatomy and Surgery, University of Illinois, College of Medicine

In the course of experimental work to determine whether or not regeneration of the thyroid occurs after ablation and what effect, if any, the capsule has in this process, the writer discovered that even in the normal thyroid of the dog there is evidence of destruction and new formation of follicles. In perusing the literature he found that no reference is made to such events in the normal life of the thyroid. Consequently it was deemed advisable to focus attention on these processes before proceeding with the major problem in mind.

The question arose whether there is a uniform type of follicle unchanging in shape and size or whether there are types differing in these characteristics. A second question pertained to the importance of the cell groups scattered between the follicles which are known in the literature as the interfollicular or interstitial cells. Hitherto most investigators in their studies of the thyroid gland have only emphasized the follicles and the enclosed colloid and have hardly given any attention to these cells. Indeed histological textbooks make little note of such features. The observations presented here show that the interstitial cells certainly are as important as the follicular cells, a fact which becomes evident especially when the relations existing between the follicles and the interfollicular cell groups are taken into consideration.

MATERIAL AND METHODS

The thyroids of 14 dogs were examined in the course of this study. The material was obtained by biopsy. Both glands were exposed and the ventral half of each was removed under proper precautions to prevent any damage to tissue. The dorsal half was left in its normal place for other studies. The specimens were immediately put into formalin or Mueller's solution and were afterward embedded in paraffin and cut into serial sections 10 micra in thickness. The majority were stained with hemotoxylin and eosin, and a few by van Gieson's method. In every case the tissue of both glands was studied, and care was taken to eliminate glands which were suspected of any pathologic changes.

OBSERVATIONS

1. *Concerning the growth of follicles.* In many cases the follicles may show little variation in size, but upon comparison with other areas the differences in size become more evident (Fig. 1). Very small follicles—probably of young age—are usually arranged in a group. These really are small follicles and cannot be interpreted as caps of larger follicles sectioned tangentially, because they lie close to each other and the follicular wall is represented by a single layer of cells. Were they caps of larger follicles cut at a tangent, it is obvious that the wall would appear to be composed of several layers of cells. The correctness of the above interpretation was further established by tracing such follicles through the series, when it is found that their lumen does not increase in size in the following section. In section the simplest follicles seem to consist of three or four cells only. The central poles of the cells of such a small group show the same staining as the colloid in young follicles, and there can be no doubt that the colloid is a product of these cells. In another stage, perhaps slightly more advanced, a small droplet of colloid is already present in the center of the group and yet connected with the surrounding cells. One single section often reveals all the different stages between large areas of middle sized follicles. During their growth the follicles expand by a numerical increase of cells proportionate to the diameter. It need not be decided here whether the number of follicular cells grows by cleavage or by the invasion or incorporation of interfollicular cells into the follicular wall and there becon-

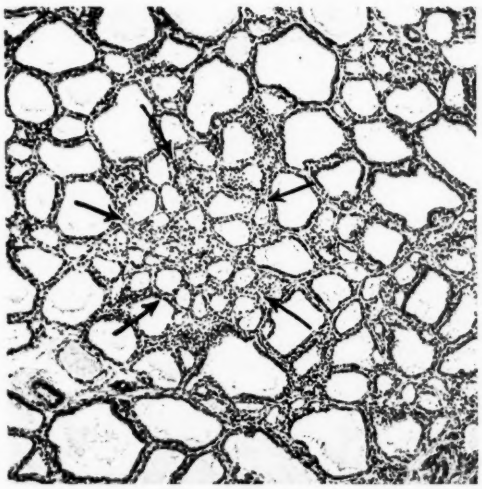


Fig. 1. Photomicrograph of a section of thyroid of dog. ×90.

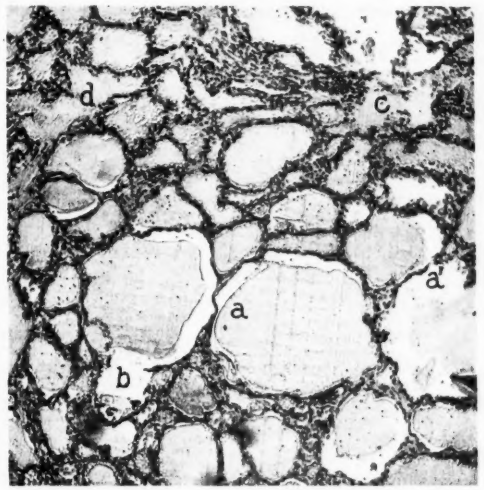


Fig. 2. Photomicrograph of a section of thyroid of dog. Follicles indicated by *a* and *a'* showing beginning fusion with adjoining follicles; at *b* two follicles have become broadly confluent; at *c* numbers of compressed follicles have coalesced with one another to form irregular colloidal spaces; *d*, colloidal space. ×110.

ing follicular cells, as suggested by Huerthle.[1] It is improbable that a follicle grows merely by distension caused by the accumulation of colloid, for no large follicles exist which are lined by a small number of cells.

[1] Huerthle, K. Arch. f. Physiol., 1894, lvi, 56.

2. *Two types of follicle destruction.* The epithelium of the fully developed follicles is usually cuboidal but may assume squamous

Fig. 3. Photomicrograph of a section of thyroid of dog. At *a* large colloidal space formed by the breaking up of many follicles and containing the cellular débris resulting from such disintegration. At *b* an area of collapsed follicles. ×110.

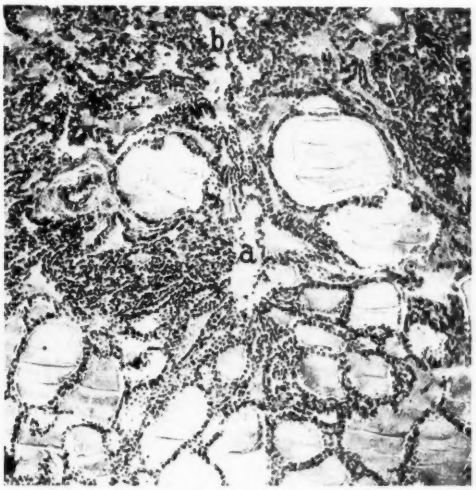


Fig. 4. Photomicrograph of a section of thyroid of dog. At *a* and *b* irregular colloidal spaces formed by the fusion of regressive follicles; note the shreds of epithelium and scattered cells in their cavities; also the compressed or collapsed follicles radiating from these irregular cavities. ×110.

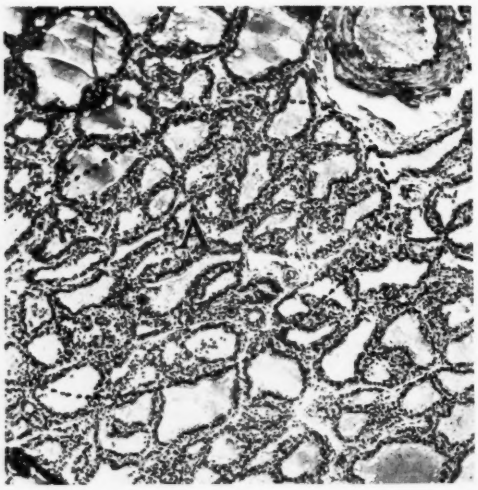


Fig. 5. Photomicrograph of a section of thyroid of dog. The territory outlined (by dotted line) and indicated by *A* reveals early stages in the collapse of follicles. ×110.

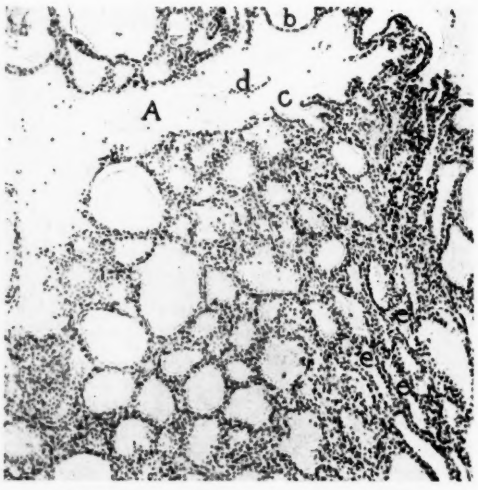


Fig. 6. Photomicrograph of a section of thyroid of dog. *A* represents a large colloidal cavity formed by the flowing together of follicles. At *c* a small follicle just merging with the larger cavity; at *b* an epithelial wall just before breaking away during the process of follicular fusion; at *d* vestiges of such epithelial walls; at *e* compressed or collapsed follicles. ×110.

character at points at which two follicles are in contact with one another. Finally their walls break through at such points, and a larger space results which is filled with colloid and lined with the rests of the epithelium,

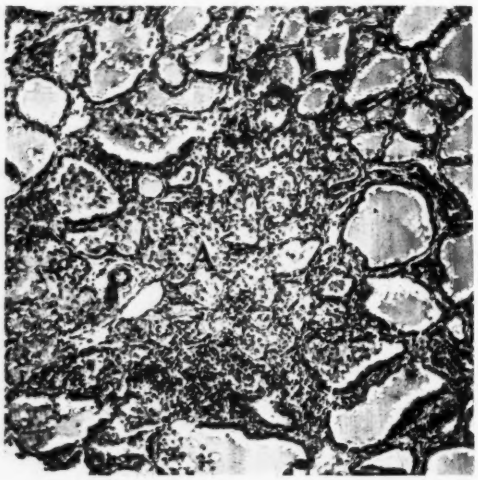


Fig. 7. Photomicrograph of a section of thyroid of dog. At *A* an early stage in the disintegration of a large group of follicles, with the scattering of their cells engulfed in colloid. Near the lower left half margin of picture the walls or outlines of the original follicles are still barely visible. ×110.

(Fig. 2, *a* and *a'*). Sometimes more follicles fuse and create still larger colloidal spaces which in extreme cases appear like cysts (Figs. 2, *c* and *d*; 3, *a*; 4, *a* and *b*). They differ from cysts, however, by being lined not by a continuous epithelial layer but by fragments of such which often project into the colloid of these spaces (Fig. 4, *a*). There may be a relation between such a normal event and the formation of a cyst which could develop either by the growth of a single follicle or the fusion of many follicles (Fig. 6, *A*). In some localities the fusion occurs so rapidly that parts of the follicular wall are engulfed by colloid (Fig. 6, *A* and *d*), the cells seeming to dissolve entirely in it and their protoplasm becoming indistinguishable as such. The pycnotic nuclei which become evident during the regressive changes finally disappear also. As for the colloid it is difficult to say whether it is resorbed from these large cavities.

Another type of follicular destruction occurs without involving the degeneration and death of the individual cells and represents merely a cellular rearrangement with reduction in the amount of colloid. Follicles undergoing

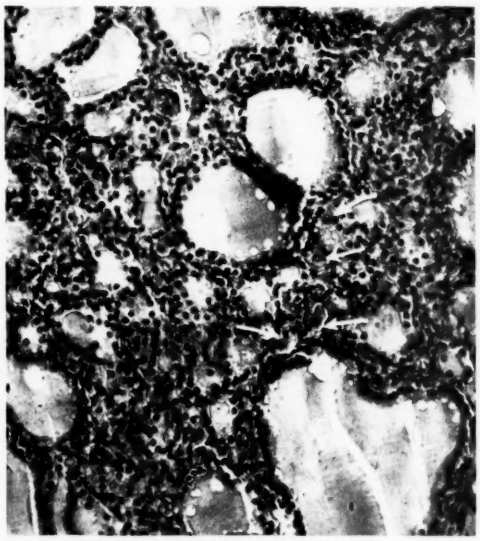


Fig. 8. Photomicrograph of a section of thyroid of dog. New formation of follicles may be observed in a cell group originating from destroyed follicles. Arrows indicate large cells described in text. ×210.

this method of regression assume a collapsed and compressed appearance so that their epithelium extends in double parallel rows (Figs. 2 to the left of *c;* 3, *b;* 4, to the left of *a;* 5, *A;* 6, *e*). In time these rows break up, resulting in groups of cells without any definite organization (Fig. 7, *A*). The fact that such retrogression of follicles is seen among normal follicles in the depth of the gland no less than at the surface is sufficient evidence that it is not an artefact caused by handling. With the breaking up of the follicles, the colloid becomes scattered in the form of small irregular masses and particles between the cells and ultimately vanishes completely.

Like the first type of follicular destruction described, this type likewise may involve a larger number of follicles associated in a group.

3. *The interfollicular cells.* Two kinds of interfollicular cells can be distinguished. One variety of cell group may probably be considered as having remained embryonic in nature and as awaiting the development in follicles, and the other as arising by the breaking up of follicles. Cell groups of the former

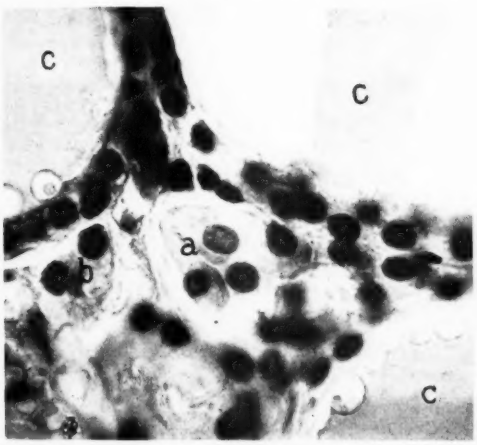


Fig. 9. Photomicrograph of a section of thyroid of dog. *a* represents a group of large cells, with homogenous cytoplasm containing nuclei with a very distinct chromatin network. At *b* two interfollicular cells almost identical with cells lining follicles. *c* indicates "normal" follicles. ×500.

variety show considerable similarity with embryonic thyroid tissue and here and there reveal small follicles lined by few cells. They are far more frequent in the glands of younger animals than in those of old ones in which corresponding places are composed for the most part of small follicles (Fig. 1). In many

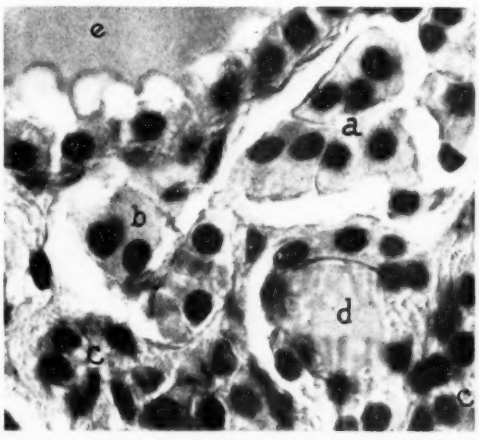


Fig. 10. Photomicrograph of a section of thyroid of dog. *a* and *b* indicate groups of large interfollicular cells, probably a short period before fusion of the central poles. At *c* groups of cells originated from destroyed follicles. *d* represents small young follicle and *e* large and old follicle. ×500.

cases it is difficult to differentiate between aggregates of embryonic cells and such arising from regressive follicles. All stages between follicles normal in appearance and cell groups resulting from their destruction exist and can be observed. In other words, no sharp division can be drawn between the several steps, so gradual is the change from the former into the latter. It is clear that the morphology of the interfollicular cell groups can be understood only by the study of their development.

In all groups of interfollicular cells originating from follicular destruction two different types of cells have been found. First there are cells—the prevailing type—which are similar to or identical with cells that line the follicles. They are cuboidal or cylindrical in shape and contain a nucleus which is generally elliptical, but may occasionally be round. It takes a dense stain and shows no finer structure. The other type of cell is larger, is almost spherical and possesses a homogenous protoplasm and a large, lightly staining nucleus with a distinct net of chromatin. The cytoplasm colors brightly with eosin, and since such a cell occurs in groups of 2 or 6, these groups appear as little pink spots between the surrounding cells and represent the origin of new follicles (Figs. 8 to 10). Superficially at least their protoplasm seems to be identical with colloid. In studies on the thyroid, other authors have hardly recognized these two types of interfollicular cells, hence they are deserving of further investigation.

CONCLUSIONS AND SUMMARY

The present observations show that the follicle is not the only structure of morphological importance in the thyroid gland. The study of the interfollicular cells reveals that between these two extremes of morphological composition there are many stages of transition. The follicle is not a permanent structure but merely a phase in structural metamorphosis which alternates between two extremes; the follicle on one end and the interfollicular cell group on the other.

Follicles break up and after the lowest point of disorganization is reached the reorganization of new follicles commences from cells which are spherical, are larger than follicular cells, and possess a cytoplasm that is homogenous and stainable like the colloid itself, and a nucleus that is large and chromatic. On the other hand the cell of a large or "old" follicle is cuboidal, the cytoplasm is poorly stainable and the nucleus more or less pycnotic and elliptical. For the most part the process of destruction strikes the follicle and not the cell. The latter merely accepts a different arrangement. However, where the formation of large colloidal spaces occurs by the coalescence and confluence of follicles, some cells become engulfed, undergo dissolution and disappear in the colloid.

From these observations there is evidence to assume that during the life cycle of the thyroid a cell may appear and reappear in successive follicles, for new follicles are formed from the cellular components of disintegrated follicles. It may be supposed further that a cell is able to produce colloid but for a limited period, and then requires a period of inactivity to prepare itself for a renewal of secretory function in company with like fellows—the interfollicular cells—which together initiate a new follicle.

The regression of follicles seems to facilitate the resorption of colloid. The disintegration of their walls permits the colloid easily to escape and to appear among the surrounding cells. Here too such material finally disappears.

If these interpretations of the observed conditions are correct, then a new basis is given for the understanding of the pathology of the thyroid. It is conceivable how differences in such pathology may result from the unbalance or overemphasis of any one phase in the follicular life cycle of the thyroid.

CLINICAL SURGERY

FROM THE RUDOLFSPITAL, VIENNA

VAGINAL EXTIRPATION OF THE UTERUS AND ADNEXA ON BOTH SIDES

PROFESSOR DR. PAUL WERNER, VIENNA, AUSTRIA

IN the September, 1929, issue of SURGERY, GYNECOLOGY AND OBSTETRICS, I described a simple method of extirpating the uterus by the vaginal route. If it is necessary to remove the adnexa as well as the uterus, extirpation may be accomplished after the hysterectomy by pulling down the organs on one or both sides and excising them. This operation is not exactly easy; indeed, it may be difficult even to the experienced operator if adhesions are present, but such difficulties may be avoided or considerably lessened, if the uterine extirpation is modified as I shall describe. The idea of the modification is to split the uterus *in situ* and to extirpate each half with its adnexa.

This operation is indicated when inflammatory adnexal tumors with perimetrial adhesions are present and conservative treatment has failed, thus making total extirpation ultimately necessary. The method is useful also in vaginal hysterectomy for bleeding or for fibroids, especially when technical difficulties present themselves, such as obscure anatomical relations, reflected peritoneal folds, or similar difficulties, which make the approach difficult. The operator will be surprised how much easier hysterectomy may be performed if the uterus is split. A further great advantage of the operation is that the difficult seeking and opening of the anterior fold of Douglas are avoided, also that it is not especially essential that the posterior fold of Douglas be sought. The posterior fold of Douglas is generally easy to find, but at times it may be rather difficult to locate and open. As will be explained, opening of the peritoneum occurs spontaneously. The operator, who knows how often in old chronic inflammation of the pelvis, the excavatio vesico-uterina becomes obliterated or drawn sideways, will appreciate these advantages. A further advantage of the splitting method is that extensively adherent adnexa may easily be drawn down into the field of operation by pulling on the corresponding part of the uterus. The adnexa may then be loosened from their adhesions and extirpated.

In vaginal operations it is generally necessary that the organ to be removed be entirely mobile. Even staunch advocates of the vaginal route would hardly use this route in removing an ovarian cyst, for example, if the ovary were adherent to the surrounding structures. The operation which I shall describe makes this important requirement unnecessary, for in cases of inflammatory adnexal tumors it is possible to pull down the tumors with sufficient force that the adhesions to the corresponding part of the uterus may be loosened under the guidance of the eye, not only with the fingers but also frequently with instruments such as scissors and knife. It may well be noted here that my operation is especially applicable in cases in which the uterus is fixed. More or less marked changes in the adnexa are to be found in such cases. These changes may be overlooked on clinical examination because of the position of the adnexa above and to the side of the corpus uteri which lies deeply in the pouch of Douglas. A further advantage of the vaginal route is that the field of operation is close at hand thus eliminating the necessity of deep narcosis during the freeing of adhesions and at the same time overcoming some of the technical difficulties of the abdominal route.

Convalescence is generally very rapid and smooth. The danger of peritonitis, which always threatens after a laparotomy, especially when large pus pockets have been opened, is altogether absent or is very slight. The infectious material flows out through the vagina and does not spread into the abdominal cavity or even touch the higher parts of the peritoneum. Now and then, suppuration of the abdominal layers is likely to occur after the abdominal removal of inflammatory tumors; but if the vaginal route is used, one need not be concerned with this complication.

Fig. 1. *1*, Exposed cervix wall; *2*, cutting surface.

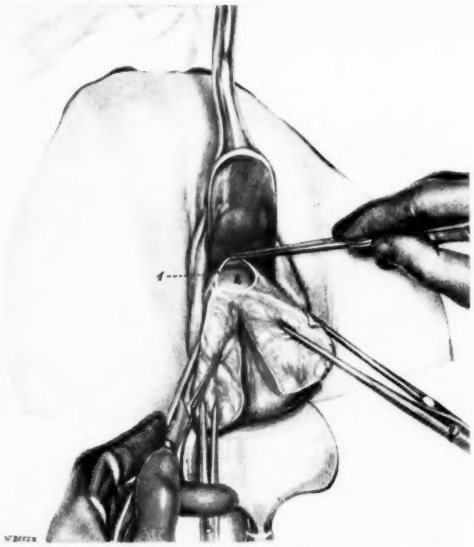


Fig. 2. *1*, Plica; *2*, anterior surface of the body; *3*, split cervix.

Finally, we must not forget that here as in all vaginal operations convalescence is short and relatively painless and the patient is able to return to work in a relatively short time.

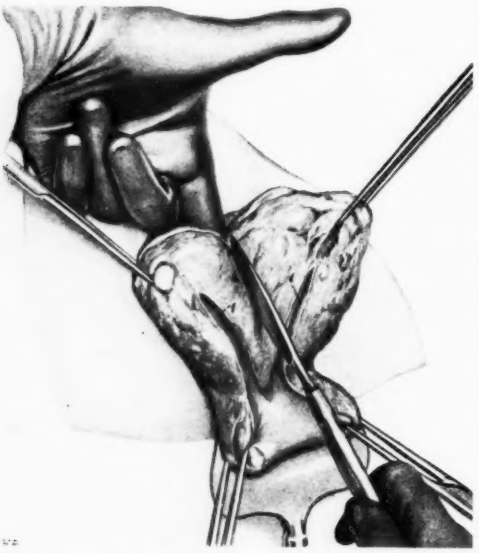


Fig. 3. *1*, Uterine cavity; *2*, posterior wall of the uterus.

Indications. I have already mentioned that this procedure is indicated in cases with inflammatory genital affections of all sorts, especially when the uterus is fixed in retroflexion. It is indicated also in the presence of old parametritical exudate and of scars which no longer respond to conservative therapy. In such cases resorption of the infiltrated material occurs only after removal of the uterus. If the tumor is large enough to reach to the navel, it is better not to use the vaginal route as we do not know whether the adhesions high up in the abdominal cavity can be loosened by a pull, even a strong one, from the direction of the vagina. These cases are very rare, however.

Anæsthesia. Only inhalation narcosis or spinal anæsthesia is to be considered. Local, sacral, and parasacral anæsthesia, is eliminated because complete anæsthesia is not to be expected from it. If adhesions reach high up in the pelvic peritoneum, a general anæsthetic is necessary. Personally I prefer pure ether narcosis, which has always proved sufficient and, because the operation consumes little time, carries very little danger with it.

Pre-operative treatment. Special pre-operative treatment is not necessary. The bowels must be emptied on the day previous to the operation. An enema on the day of the operation should be avoided because retained water might pass during

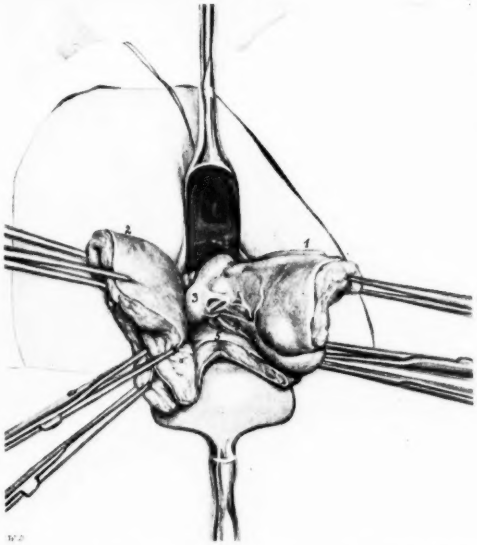


Fig. 4. *1*, Left half of the uterus; *2*, right half of the uterus; *3*, left tube; *4*, adhesions; *5*, peritoneal covering of Douglas's pouch.

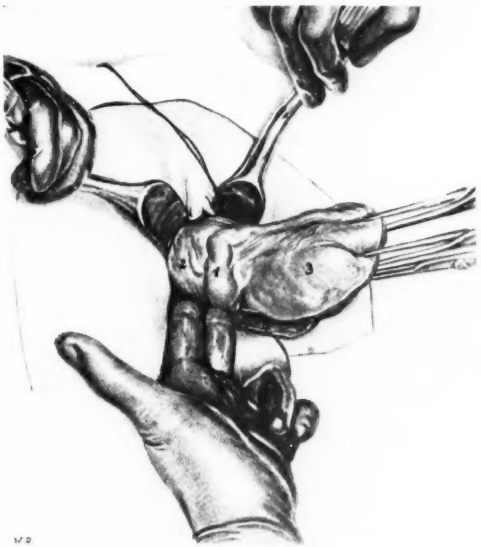


Fig. 5. *1*, Tube; *2*, ovary; *3*, left half of the body; *4*, left half of the cervix.

the operation and endanger asepsis. Half an hour before the operation the patient is given 0.02 pantopon and 0.0003 atropin subcutaneously.

TECHNIQUE

After the patient is placed on the operating table the vagina is exposed with retractors and the cervix is grasped with tenacula and pulled down. It is advantageous to use two tenacula on the anterior lip and one on the posterior lip. In this way a greater pull can be exerted without the danger of the tenacula tearing out. Immediately above the cervix a transverse incision is made through the anterior vault of the vagina and the bladder is loosened from the anterior wall of the cervix exactly as described in my previous article on the extirpation of the uterus. In simple extirpation of the uterus, the operator at this point tries to open the peritoneum of the vesico-uterine fold; in my operation, however, that is quite superfluous. A retractor is introduced between the bladder and the anterior wall of the cervix and the latter is split with scissors as far as it is free of the bladder (Fig. 1). Now both tenacula which were inserted in the anterior lip of the cervix are inserted immediately below the upper end of the cervical cut. With the finger it is determined whether the bladder is entirely separated and if separated the incision is then carried upward as nearly as possible in the middle line. Thus the plica vesico-uterina is opened (Fig. 2). The anterior retractor is now introduced through the

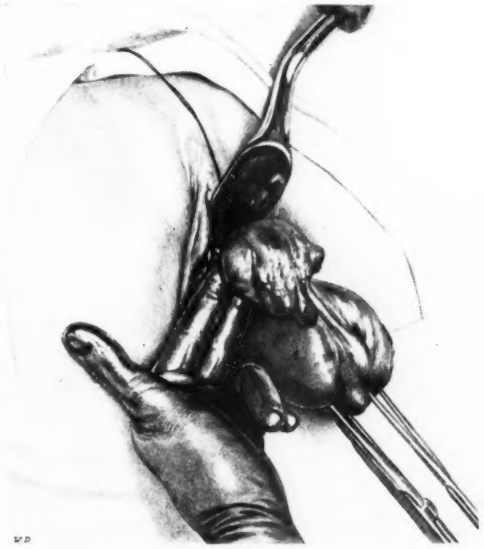


Fig. 6. *1*, Uterus and *2*, tumor.

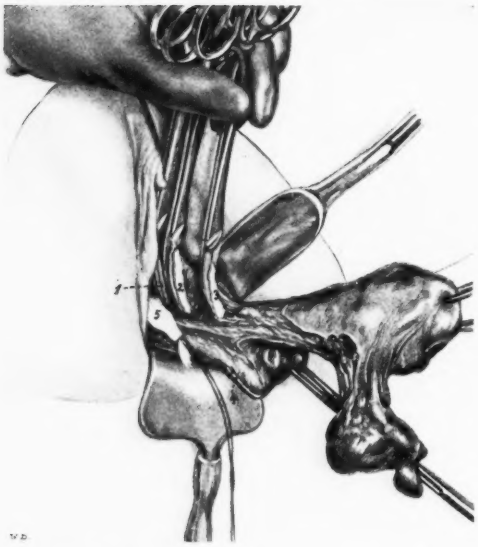


Fig. 7. *1*, Infundibulopelvic ligament; *2*, round ligament; *3*, uterosacral ligament; *4*, posterior wall of the vagina; *5*, gauze pack.

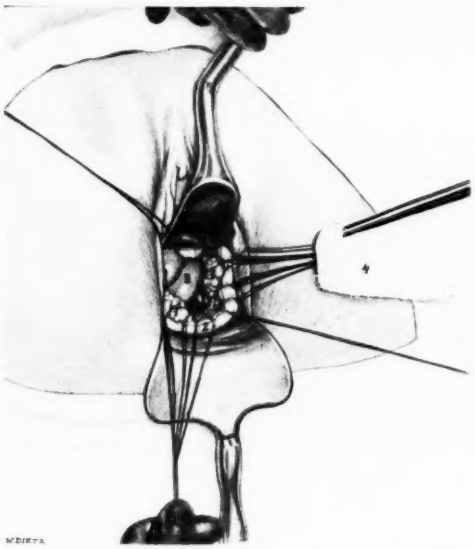


Fig. 8. *1*, Stumps; *2*, posterior vaginal wall and peritoneum; *3*, bowels; *4*, gauze.

newly made hole into the peritoneal cavity and by gradually climbing higher with the tenacula the splitting in the median line is continued. The adhesions on the uterus may first be loosened with the finger. When the incision has reached the fundus it is generally possible to pull it before the vulva and the splitting can be continued through the posterior wall down to the posterior lip of the cervix either by scissors or with a knife, as in Figure 3. Figure 4 shows the uterus split in two parts and pulled apart. When the uterus is thus pulled apart the adnexal tumors appear in the depth. In our picture the observer is looking at the field from the right side. If the splitting is really done in the median line there is no bleeding worth mentioning because the blood vessels enter the uterus from the side and go toward the median line so that the field of operation is relatively anæmic and the larger vessels are not cut.

The next step is the freeing of the adnexal tumors and the extirpation of them together with the part of the uterus to which they are attached. I make it a practice to loosen and remove first the tumor of the side which seems less difficult to handle. The advantage of this is that then there is more room in which to work in loosening and extirpating the more adherent tumor. In the case described the left side seemed to present less difficulty. Therefore, the right half of the uterus was put back into the peritoneal cavity and the left half was pulled down. This manipulation caused the adnexal tumor to descend markedly toward the vulva and to come well into sight (Fig. 5). In Figure 6 the tumor is shown freed of its adhesions and connected with the pelvis only by the ligamentum infundibulopelvicum. The freeing was done with the index and middle fingers of the left hand, that is, the hand corresponding to the left side of the pelvis of the patient. As soon as the tumor is completely freed, that is when the tumor is pedunculated, I begin to separate the tissue from the ligamentum infundibulopelvicum after having attached clamps; and after the ligamentum infundibulopelvicum the ligamentum rotundum, and then the ligamentum latum and finally the ligamentum sacro-uterinum and that part of it belonging to the posterior wall of the vagina. Figure 7 shows this part of the operation. There now remains only a part of the ligamentum sacro-uterinum and the posterior wall of the vagina to be extirpated. The parts of the ligamentum latum which lie higher up have already been clamped and separated. Finally when the part of the uterus with its adnexa has been extirpated, ligatures are placed and the clamps removed (I use only catgut).

We now are ready to take care of the opposite side and we carry out the same procedure here

As already mentioned it is generally easier to work as there is more space for the operating hand.

When both sides have been freed of the tumor the peritoneum of the bladder is fixed to the anterior wall of the vagina, the Douglas peritoneum to the posterior wall, and the stumps of the ligamentum latum to the lateral edges of the incision. The ligamenta infundibulopelvica frequently inflamed and infiltrated are generally too short to be brought to the edge of the vagina. They are allowed to slip back into the abdominal cavity without further care. Figure 8 shows the peritoneum and the stumps fixed as far as possible to the cut edge of the vagina. In the cavity intestinal loops are visible. Since it is generally impossible to check bleeding completely when inflammatory tumors are freed of their adhesions and removed, the peritoneal cavity must not be closed but should be kept open to allow drainage. For this purpose, a strip of iodoform gauze is placed loosely in the peritoneal cavity and led out through the vagina.

The fear that prolapse of the intestines may occur is unfounded as has been proved through experiences with many hundred cases.

AFTER-TREATMENT

The after-treatment is very simple. Beginning on the fourth day after operation, a piece of the strip of iodoform gauze is pulled out each day and cut off so that finally on the seventh or eighth day the whole strip has been removed. Two days after the complete removal of the gauze, vaginal douches, generally of a solution of potassium permanganate, should be given. As early as the third or fourth day after operation the patient may get up and as a rule on the eighth to tenth day she is able to leave the hospital. It is desirable that before she leaves the hospital the patient be examined once more on the table. The vagina is exposed with retractors and the granulating wound is inspected. If necessary, tincture of iodine is applied. Vaginal douches must be continued until the discharge, which exists after every such operation, disappears.

FROM THE SURGICAL CLINIC, UNIVERSITY OF HEIDELBERG

TECHNIQUE OF THYROIDECTOMY

MORRIS L. PARKER, M.D., CHICAGO
Formerly Exchange Assistant at The Surgical Clinic, University of Heidelberg, Geheimrat Enderlen, Director

ABOUT 20 per cent of the entire population of the Middle Rhine District is affected with goiter. These are colloid in type and vary in size from those which are barely noticeable to those of extreme dimensions, producing symptoms of compression. The incidence of toxicity is small, about 10 per cent in the cases operated upon. Primary hyperthyroidism is rare.

In Germany, all working people are members of a Krankenkasse.[1] During the period when goiters were recognized by these institutions as a condition warranting full compensation, the number of thyroidectomies in this clinic was about 600 annually. Since this compensation has been decreased, the number has diminished to approximately 250.

INDICATIONS

Aside from primary hyperthyroidism, or toxic adenoma, pressure symptoms are the chief reason for the operation. As the figures mentioned indicate, the operation is seldom performed for cosmetic effects. The goiters seen here are usually large, generally substernal, producing displacement of the trachea, with consequent cough, dyspnœa, and occasionally difficulty in swallowing. Stimulation of the sympathetic, as characterized by Horner's syndrome, and irritation of the recurrent laryngeal nerve, characterized by hoarseness, are frequently present on admission. The patients postpone operation as long as possible. Secondary myocardial changes, particularly hypertrophy and occasional cardiac irregularity, are therefore frequently noted.

PRE-OPERATIVE TREATMENT

The pre-operative treatment is not of as much importance as in the toxic cases. A complete general examination, to determine the condition of the patient as to being an operable risk as well as the presence of coincidental diseases, is essential. Basal metabolic rate is determined only in cases of suspected toxicity. All patients are examined with the fluoroscope to determine whether the trachea is displaced or compressed as well as to ascertain whether the gland is substernal and, if so, whether it is movable. The condition of the heart and lungs is observed at the same time. Laryngoscopic examination is performed almost routinely and particularly in individuals using the voice a great deal, as actors, singers, and priests, to detect any involvement of the laryngeal nerve which may be present without symptoms and cannot be determined otherwise. In cases where indicated a few days' rest is permitted and cardiac therapy instituted. Patients who have toxic symptoms are treated with Lugol's solution, which is given in sufficient quantity and over a period until the condition warrants operation.

ANÆSTHESIA

All operations, except in the occasional highly toxic case, are performed under local anæsthesia. The technique of the method is simple, it absolutely excludes pain, renders the field relatively bloodless, avoids additional damage to the already overburdened heart, lungs (in the presence of emphysema), and compressed trachea. What is more important, it enables the operator to converse with the patient and thus minimize injury to the recurrent laryngeal nerve. Using 1 per cent novocain with adrenalin, 15 to 20 cubic centimeters is injected subcutaneously at the level of the incision from one sternomastoid to the other. The middle of the sternomastoid at its posterior border is located, and the injecting needle is inserted at this point. Ten cubic centimeters is injected subfascially on both sides along the entire muscle to block the anterior cervical nerves. Now the superior pole is located and another 10 cubic centimeters injected. This suffices in practically all cases (Fig. 1). The presence of adrenalin in the mixture prolongs the duration of the anæsthesia for 2 to 3 hours. In large goiters and those which extend a considerable distance behind the sternum, paravertebral injection may be added over the second, third, and fourth transverse processes of the cervical vertebræ. Frequent aspirations of the syringe must be made during the process of injection to detect possible entrance into a blood vessel. The paravertebral procedure is associated with some degree of danger and is not generally used. With a previously adminis-

[1] Krankenkasse is an organization of social insurance providing compensation in case of illness or accident, civil or industrial. All people with an income of 6,000 marks per year or less (about $1,500.00) are compelled to have this form of insurance. Thus a large majority of the working people and their families are protected and cared for by these institutions.

tered injection of morphin and atropin the patients go through the operation without discomfort. In very toxic cases and in children, general anæsthesia may be added if the patient is very excitable or the conditon requires it, but it is used in less than 1 per cent of the operations.

TECHNIQUE

As stated above, the goiters operated upon here are usually large. Pathologically, they can be grouped as follows: (a) large nodular or adenomatous goiter; (b) diffuse parenchymatous (very vascular and pulsating); (c) diffuse colloid. As a fourth group may be added the primary toxic type. In cases of large goiters, very careful and gentle manipulation as well as anatomical progression are essential to avoid danger to the adjacent structures. The position of the patient should be such as to permit extension of the neck without at the same time producing discomfort or interference with respiration. The patient lies on a flat table with a pad under the shoulders, the back of the head resting on the table. The head of the table need not be elevated. The patient is draped and the face is covered with sterile linen. An ether mask is put over the mouth and nose to make breathing easier. The operator is at the right of the patient, the first assistant at the left, and the second assistant at the head end of the table, so that everyone has ample working space.

The skin incision, which includes the platysma, is of the usual Kocher type, transverse or curved, depending on the size of the goiter, and placed so as to allow sufficient exposure and at the same time give a satisfactory cosmetic result. The skin is deflected upward as far as the thyroid cartilage and then held in place by towel clips. The large veins lying on the surface of the fascia are doubly ligated and divided, to avoid possible air embolism later. The prethyroid strap muscles (sternohyoid and sternothyroid) are then divided transversely without clamps and without dissecting off the fascia from underneath one sternomastoid to the other (Fig. 2). All bleeding points are ligated. The gland is thus well exposed and can be delivered with comparative ease (Fig. 3).

The essential principles in the technique are as follows: careful isolation of all structures, thorough hæmostasis, and elimination of as many clamps as possible. The cut ends of the strap muscles at the right upper pole are retracted. By gentle manipulation with the finger, pulling down on the thyroid tissue in that region and loosening the connective tissue web with a Kocher dissector, the vessels of the superior pole are exposed. Each vessel is individually isolated, doubly ligated, and

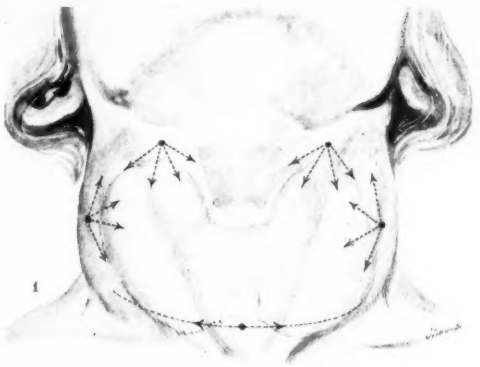


Fig. 1. Scheme for local anæsthesia. Injection along line of incision at middle of sternomastoids and over superior poles.

divided. The superior thyroid artery is ligated with three ligatures, one being left on the proximal and the others on the distal end (Fig. 4). A clamp is now applied to the thyroid at the upper pole. The mobilization of the right lobe is begun. This is accomplished by retraction of the sternomastoid, ligation of the lateral and inferior thyroid veins, and separation of the fine connective tissue which is adherent all around the lobe. This permits complete mobilization and dislocation of the gland medially. At this time the inferior thyroid artery comes clearly into view. The inferior thyroid artery comes from the thyrocervical trunk lateral to the carotid, travels upward, and at the level of the transverse process of the sixth cervical vertebra appears from under the carotid and goes medially almost straight across to enter the gland. It is easily isolated at this point and is doubly ligated lateral to where it enters the gland and close to where it crosses the carotid. It is not divided, in order not to disturb its anatomical relationship to the laryngeal nerve. The recurrent laryngeal nerve, running generally beneath, occasionally above, and sometimes between the terminal branches of the artery, about 1 to 2 centimeters from the trachea at this point (Fig. 5), is seen at the same time (4). The lower pole is now mobilized and if substernal may be dislocated upward with impunity, as there is practically no danger of hæmorrhage, particularly if not too much tension is applied to tear the thyroid. If it is difficult to bring up the substernal portion, traction may be applied by means of tension sutures or clamps. Cutting of the sternum is too dangerous and is generally unnecessary. On the left side a similar procedure is carried out, and when it is completed

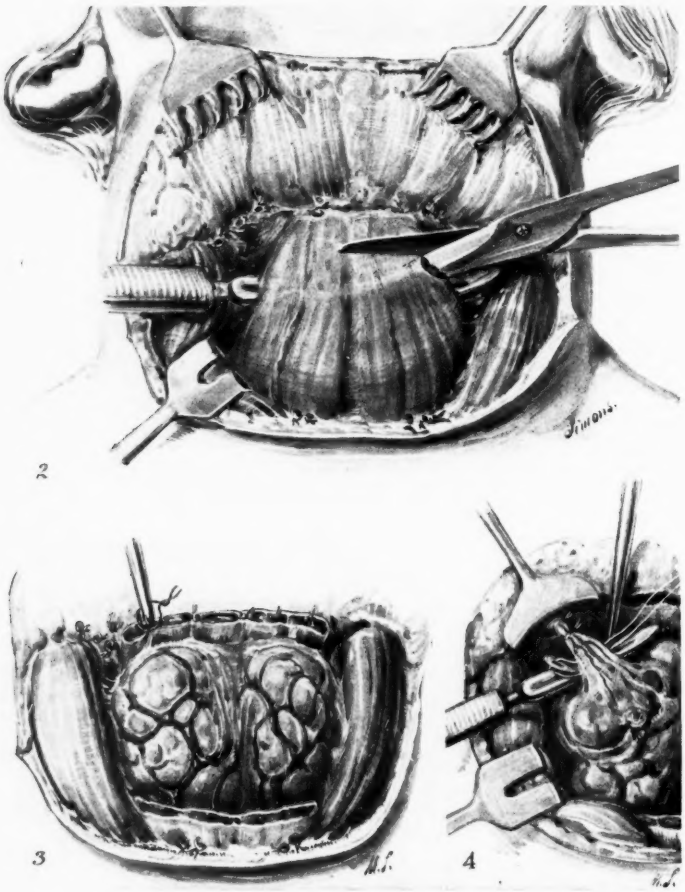


Fig. 2. The strap muscles, together with the overlying fascia, are cut from one side to the other. The sternomastoids are retracted laterally.

Fig. 3. Appearance of field after muscles have been cut and vessels ligated. The thyroid is exposed.

Fig. 4. Ligation of superior pole. The vessels are usually isolated individually and doubly ligated.

the pyramidal lobe is dissected free. The isthmus is then divided by passing a Kocher dissector between it and the trachea, cutting over the dissector as a guide (Fig. 6).

The thyroid is now separated by means of sharp dissection, so that only the fine web-like connective tissue on the surface of the trachea is left. Both lobes of the gland are now entirely free, being attached for only a short distance along the trachea. The amount of glandular tissue desired, usually all except a thin layer on top of the posterior capsule, is now cut off from each lobe. The amount of good thyroid tissue necessary for body function is about the size of a hazelnut on each side. All bleeding points are ligated and each lobe remnant is sutured separately, uniting the lower with the upper pole, and the raw edges are inverted (Fig. 7). This method is considered more advantageous than the lateral suture of the thyroid stump because it restores the lobe to a practically normal shape and prevents the exudation of any secretion.

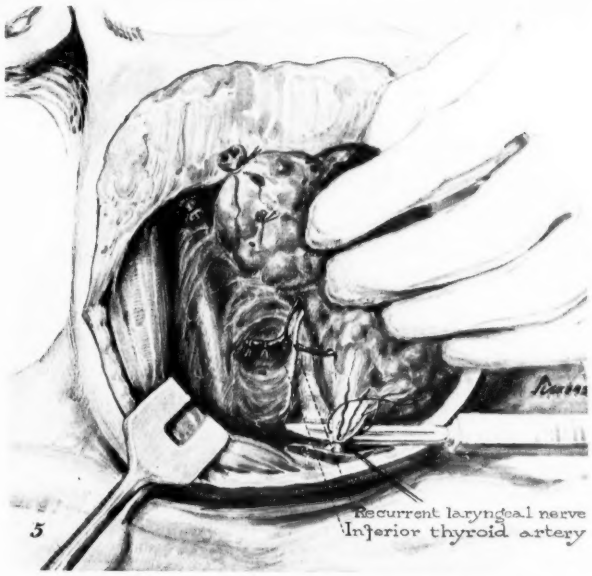


Fig. 5. Thyroid is dislocated medially. The areolar tissue behind the capsule has been loosened, exposing the inferior thyroid artery, which is doubly ligated but not cut. The recurrent laryngeal nerve is exposed at the same time.

In those cases in which the pathological process is limited to one side only, hemithyroidectomy is performed.

The patient is now asked to cough, the straining revealing any bleeding points, which are then properly controlled. The pillow is then removed from under the shoulders, permitting the neck to flex, and the strap muscles are sutured in proper alignment with interrupted sutures (Fig. 8). The fascia left adherent to the muscles does not permit the cutting through of sutures. The skin is similarly closed, and a thin glass drain is left in place at the most dependent point. A firm bandage, including the head and making a figure of eight around the upper part of the chest, is applied to exert a little compression on the neck and at the same time provide stability, thus eliminating some pain produced in turning the head.

By this technique the great dangers of the operation are avoided. There is complete exposure and mobilization of the gland. As there is little bleeding there is practically no blood lost. Hæmostasis is easily secured in the step-like procedure, each vessel being doubly ligated as it is encountered before it is cut. The parathyroid glands, which are usually on the posterior capsule, are spared, and if they are in another position are seen and avoided. Finally, the recurrent laryngeal nerve is actually seen and is not injured.

POSTOPERATIVE TREATMENT

On returning from the operating room, patients are placed in bed in a semisitting position. Fluids are given by mouth as soon as they can be swallowed without difficulty. A steam kettle is provided to relieve the tracheal irritation, and morphin is given in sufficient quantities to produce rest and relieve pain during the first day. In cases of toxic goiter Lugol's solution in appropriate dosage is added. Complications are treated as they arise, but they are relatively infrequent. The drain is removed in 24 hours, sutures on the fifth day, and patients are generally discharged on the eighth day.

COMPLICATIONS

Complications which may occur during and after thyroidectomy are as follows:

A. *Postoperative hæmorrhage*, more frequent after general anæsthesia, is one of the most feared, and justly so, because, if extensive, it may prove rapidly fatal, either from compression of the trachea, loss of blood, or substernal hæmatoma with subsequent infection. It can best be avoided

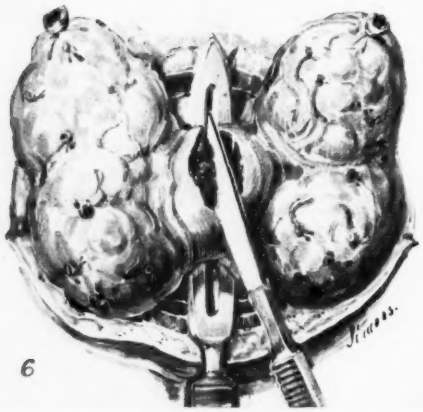


Fig. 6. A Kocher dissector is passed over the trachea and the isthmus is cut through.

by careful isolation and ligation of the particularly large vessels during the operation. However, faulty ligation is not always the cause (3). Changes in the vessel wall or retraction of muscle fibers included in the ligature, particularly at the upper pole, may allow the ligature to slip off. Moderate hæmorrhage may make itself apparent on the dressings, coming through the drain. The danger sign, however, is progressive or suddenly developing dyspnœa with cyanosis, choking spells with rapid weak pulse, indicating tracheal compression, which may quickly result in a fatal asphyxia. As soon as these symptoms appear the dressings must be loosened and the wound examined. If hæmorrhage is suspected or ascertained, the incision should be reopened and the clot evacuated. The bleeding vessel, if possible, should be caught and ligated and the wound again closed in layers and drained. If the vessel cannot be secured, and the wound continues to ooze, it should be packed with gauze and left unsutured. It may be secondarily closed in 24 to 48 hours. If the local œdema and infiltration of blood is extensive, tracheotomy may be indicated.

B. *Tetany* occurs at times (in 2 per cent of cases here) after primary thyroidectomy, but is most common following operations for recurrent thyroid where the anatomy is distorted, even if only one side has been previously removed. In this district tetany frequently occurs even following operations other than thyroidectomy. In many cases the Chvostek sign is positive even before operation. The tetany may be mild, varying from mere discomfort, tingling, and muscular spasms, to the most severe paroxysms which may terminate fatally. The presence of the Trousseau and Chvostek sign is diagnostic, and Erb's increased muscular irritability and the diminution in blood calcium are confirmatory. Tetany is a result of the removal of, or damage to, the parathyroid glands. That it does not result from insufficient blood supply to the parathyroids, subsequent to the ligation of the four thyroid arteries, has been demonstrated beyond question by the work of Enderlen and Hotz, Pettenkofer and others (1). The usual therapy consists in the administration of sedatives and calcium lactate or chloride (15 to 30 grams daily) by mouth, or 10 cubic centimeters of a 10 per cent solution intravenously. Afenil may be used for the same purpose. Dietary measures, such as the elimination of meats and the substitution of large quantities of milk, may be instituted. The feeding of thyroid and parathyroid extract alone is generally unsuccessful. Collip's extract (parathormone) is, however, valuable. Transplantation (autogenous) may be performed if the removal of parathyroid is detected and the structures recognized at the time of operation. Homeotransplants are of little avail. If the patient still possesses some parathyroid tissue the attacks may be prevented or controlled and the patient tided over the danger point, until compensatory hypertrophy occurs, by other means.

C. *Tracheitis* follows practically every thyroidectomy. It varies in degree with the amount of manipulation and tugging on the trachea. The severity of this condition is prevented and relieved by steam inhalations. Occasionally a bronchitis follows and the elevation of temperature, which generally occurs on the second and third days after operation, is said by some to be due to mild bronchopneumonia. Actual postoperative pneumonia after thyroidectomy, however, is rare, particularly following the use of local anæsthesia and in the absence of recurrent laryngeal nerve injury.

D. *Embolism* may be of two types: air embolism or pulmonary embolism.

Air embolism, resulting from the aspiration of air into the injured large neck veins, occurs, but fortunately not commonly, and never has happened at this clinic. The condition is real, and not a mere possibility, and may terminate fatally very quickly during the course of the operation if the quantity of air absorbed is sufficiently large. Aspiration of air is characterized by a hissing sound and requires immediate covering of the field with a wet sponge, then isolation and ligation of the offending vein.

Pulmonary embolism, on the other hand, is so rare after thyroidectomy, that it is generally not

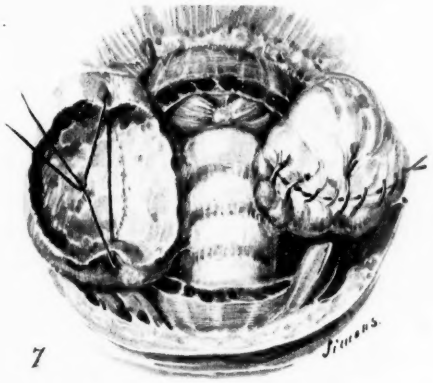


Fig. 7. After as much thyroid as is deemed advisable is excised on each side, the upper pole is united with the lower and the raw edges inverted.

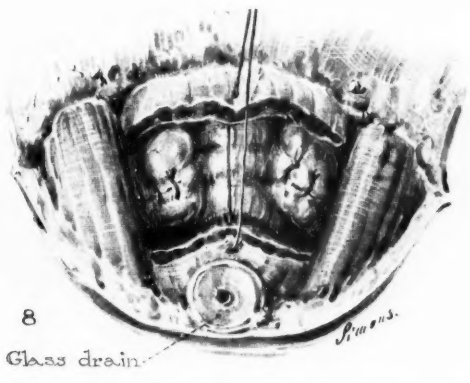


Fig. 8. The thyroid stumps have been sutured. The thyroid strap muscles are being united. A glass drain is placed at the most dependent portion of the incision.

even considered in the list of possibilities. In cases of thyrotoxicosis, the decreased viscosity of the blood and the delayed coagulability are thought responsible for this state. In cases of ordinary endemic goiter, cutting through the glandular thyroid substance during the operation may result in sufficient absorption to produce a sort of temporary artificial traumatic hyperthyroidism (2). These observations have led recently to the empirical use of thyroid extract as a preventative of postoperative thrombosis and embolism. The method, however, has not met with success in this clinic.

E. *Postoperative hypothyroidism* occurs when insufficient thyroid is left behind. Leaving 8 to 15 grams of well functioning tissue (the size of a hazelnut) on each side seems to be sufficient to maintain the body requirements and to avoid this complication. In bad goiters a larger piece must be left. If an insufficiency does occur, feeding of thyroid extract in sufficient amount will correct and prevent the progress of this condition.

F. *Injuries of the recurrent laryngeal nerve.* In the described technique, where the recurrent nerve is seen and, without being manipulated, its course observed during the operation, its severance is a rarity. Its injury, however, may occur through inadvertent application of a clamp, deep suture, or traction, and is detected at once by a change in voice when the patient is asked to phonate, or frequently by a change in breathing or a rasping reflex cough. It should be relieved immediately by removing the clamp or offending ligature. If cut, the ends should be sutured. Unilateral trauma, particularly if incomplete, results in a temporary paralysis or paresis. Complete unilateral severance produces a paralysis of the corresponding vocal cord, but the hoarseness which results disappears in 3 to 6 months, when a compensatory motion and swinging over of the other vocal cord is established. Œdema of the nerve results in temporary hoarseness, while its compression by scar tissue corresponds frequently to its severance and is a late complication. It becomes serious if the nerves on both sides are similarly involved. In this case, as when both nerves are cut, and a bilateral abductor paralysis results, phonation may be good but breathing is difficult. If the cricoarytenoideus posticus becomes involved, dyspnœa may be marked and tracheotomy essential. Death frequently results from asphyxia subsequent to choking spells or from an aspiration pneumonia.

G. *Injuries of the trachea and œsophagus* are usually rare but quite serious. They may occur in cases in which the thyroid is large, circular, and very adherent. During the process of separation the trachea may be cut or torn into, an accident favored by a softening of its wall. When detected, and the wound is small, an attempt should be made to suture it and cover with thyroid capsule. If large, tracheotomy may be necessary. If injury is not recognized, an extensive subcutaneous emphysema develops in a few hours, which requires the reopening of the wound and repair of the defect.

Œsophageal injuries result from its displacement, thinning of the wall, as well as from the presence of dense adhesions with the thyroid, thus making recognition difficult and at times impos-

sible. In case of any doubt of its integrity, the patient can be asked to swallow, or a stomach tube may be passed to determine the course. If injured, the œsophagus should be sutured in layers and the wound packed. Failure to recognize injury, or injury of its muscularis, with secondary perforation, may lead to serious infection.

H. *Tracheal collapse* occurs occasionally in the course, or soon after, thyroidectomy. It results from the contraction of the tracheal walls after the sudden release of pressure and traction, particularly in long standing, large, and substernal goiters which have for years exerted pressure on the trachea and have eroded or produced an atrophy of its rings. The condition is characterized by marked dyspnœa and cyanosis and must be differentiated from recurrent laryngeal nerve injury. Tracheotomy is the best therapy. The condition is generally fatal. To relieve it, tension sutures passed through the rings may be inserted into the sides of the trachea and brought out through the sternomastoid to the outside skin, thus widening the tracheal lumen.

MORTALITY

With the improvement in technique and proper preparation, as well as with the use of local anæsthesia, the mortality of thyroidectomy has become very small, even as compared to the other major surgical procedures. At this clinic it is almost unknown, being less than 0.5 per cent. It is limited to aged individuals with vascular and cardiac changes. Occasionally tracheal collapse, in large substernal goiters, results fatally.

RECURRENCE

Recurrence is still a question, the cause of which is not entirely clear. Various statistics in Germany show recurrence in 4 to 25 per cent of cases, particularly if the study is carried over a number of years. At this clinic it occurs in about 12 per cent. Concerning this subject, Professor Enderlen is of the opinion held by many others that, "The recurrence of the goiter depends not only on the type of the operation but also on the type of the gland. The goiter question is not yet solved."

NOTE:—I wish to thank Geheimrat Enderlen for the many kindnesses extended to me during my residence in the clinic, and for his kind permission to publish this article.

BIBLIOGRAPHY

1. ENDERLEN. Ueber Kropf. Klin. Wchnschr., 1922, No. 10, p. 460.
2. KLOSE, H. Neue Deutsche Chirurgie. 1929, xliv, 469.
3. RICHTER, H. M. Thyroidectomy. Surg., Gynec. & Obst., 1929, xlix, 67.
4. STICH and MAKKAS. Fehler und Gefahren bei Chirurgischen Operationen, p. 145. Jena: Gustav Fischer, 1923.

PHYSIOLOGICAL RECONSTRUCTION OF A THUMB AFTER TOTAL LOSS

STERLING BUNNELL, M.D., San Francisco

IN the function of a hand, motion and sensation are of equal importance and this is especially true of a thumb. The hand which is our sense organ of stereognosis is guided in its work by muscle, joint, pain, and temperature sense and by the sense of touch. We are all familiar with how awkward and useless our hand becomes when numbed with cold. When the nerves to the digits are severed the handicap to the workman is great. He is awkward and fumbles and drops objects. His hands are like the legs of a man with locomotor ataxia and cannot functionate without visual guidance. Therefore, the thumb to be reconstructed should have if possible normal sensation.

If the two volar nerves to a finger are severed that finger becomes practically useless. An annular scar still further wrecks a digit by curtailing also its lymph and blood supply. Trophic atrophy and loss of function result. If then a thumb is reconstructed by transplanting to the hand a digit from the other hand or the foot, or from a tubular pedicle skin graft taken from the abdomen and stiffened by a bone graft, there will follow trophic atrophy equivalent to that seen in a digit that has an annular scar at its base.

In some cases the reconstructed thumb will acquire a slight degree of sensation, but it will be greatly limited and not to the degree of stereognosis. A finger with volar nerves cut is permanently anæsthetic. Recently, I saw one that was still anæsthetic from severance of a volar digital nerve in the palm 20 years previously.

Strangely enough a little better sensation will be acquired in a whole finger grafted on, or one made from a tubular skin pedicle, than will follow in a finger after the two volar nerves have been severed. This is apparently because more free nerve endings start to grow down the new digit. On the other hand, when the two main nerves alone are severed these become sealed by neuromata, and the unsevered minor nerves already have their normal terminations, so that no free nerve ends are available to grow down the finger.

Unless we graft the natural nerve supply with a digit or suture the two volar nerves of the new digit to those at the base of the lost digit, the proper degree of sensation and trophic influence will not be acquired. Also, if our reconstructed digit is made from abdominal skin it will lack the specialized touch corpuscles present in a finger, so it can never acquire stereognosis to a better degree than that poor quality present in abdominal skin. To test this, press a penknife against the abdominal wall and try to identify it. A prosthesis as a substitute for a thumb is usually discarded, as it has no motion and no sensation.

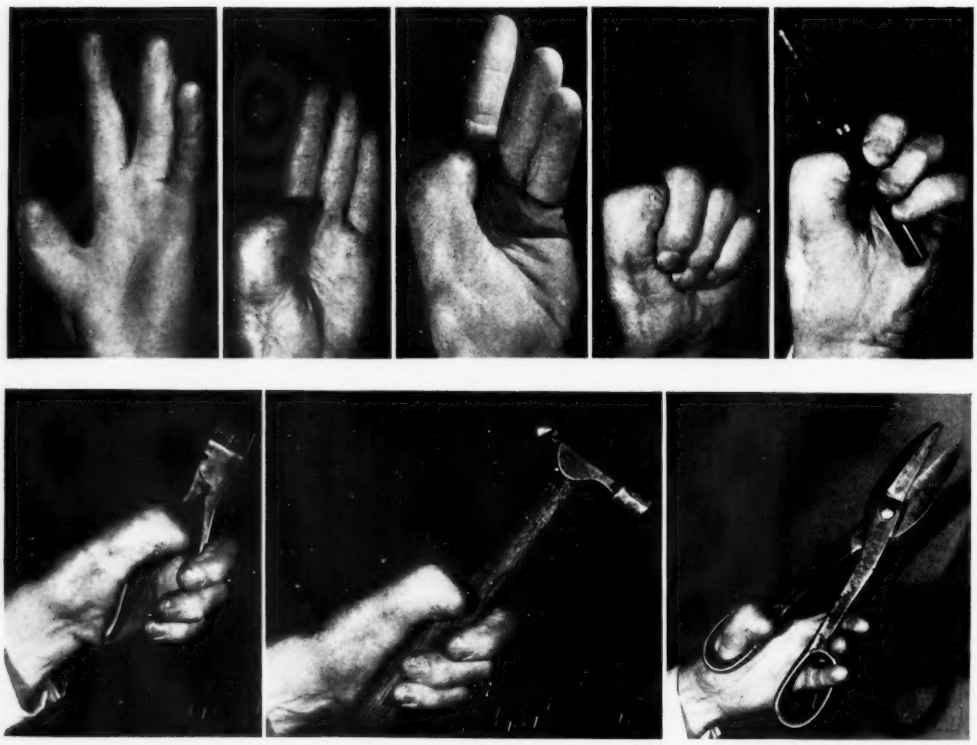
Other requisites to be sought for in reconstructing a thumb are strength, durability, movability, and the functionating position of opposition. The latter depends in the case of a movable thumb on the proper balance of the muscles and this is best obtained by attaching the normal muscles and tendons to the new thumb and in their normal relation.

In the reconstruction of the thumb to be described, the normal nerve and vascular supply were preserved and all of the muscles and tendons of the old thumb were attached in their former arrangement to the new thumb. These principles which have not been carried out in the previously reported cases of thumb reconstruction in our literature are offered as sufficiently important to be adopted whenever possible.

Case of H. W. W., aged 49 years. A year previously a circular saw amputated the thumb through its carpometacarpal joint and the index finger through its proximal phalanx. Patient had not been able to work at his trade of carpenter since the accident.

All structures necessary for making a new thumb were present and fortunately were then of no benefit to him as they were non-functionating. They consisted of the following: There was a long enough portion of the second ray

Fig. 1. Showing condition of hand before reconstruction. The thumb has been amputated through its carpometacarpal joint and also the index finger, as frequently happens, through its proximal phalanx. The hand is unfit for work.



Figs. 2 to 9. Showing results of physiological reconstruction of thumb from remains of index finger and second metacarpal. Normal nerve and blood supply have been preserved and all of the tendons and muscles of the index finger and thumb have been attached to the new digit. The thumb has movement, strength, and normal sensation including stereognosis.

for good length of thumb composed of the second metacarpal and half the proximal phalanx of the index finger. This had attached to it two flexor and two extensor tendons which could act on the metacarpophalangeal joint and also on the new joint to be constructed between the base of the second metacarpal and the trapezium. In addition, he had normal blood, lymph, and nerve supply for the new thumb which could be preserved. He also had the normal specialized sense organs of the skin of the hand which convey impressions of stereognosis in a refined way. For attachment to the transplanted member were all five muscles of the thenar eminence with their normal nerve supply, the long flexor tendon of the thumb, and the three extensor tendons, also the four tendons of the index finger. Thus, eight tendons and five thenar muscles, which were already balanced, were more than ample for stability and strength and most of them were already educated for use in thumb function.

Operation. April 10, 1929. Skin flaps were so constructed that a flap from the dorsum of the hand was utilized to close in the raw surface of the newly constructed thumb. Another flap from the palm was made to cross the bottom of the cleft between the new thumb and the hand, so as to maintain the depth of the cleft.

The old scars in the hand were excised. The two tender neuromata of the nerves to the amputated thumb and the two to the amputated index finger were dissected out and cut off after the main trunks had been ligated and injected with alcohol to prevent reformation of neuromata.

The remains of the index ray which consisted of half the proximal phalanx, the two flexor and extensor tendons, nerves, and blood vessels and the metacarpal were transplanted *en masse* to the position of a thumb, ample blood supply being left in the posterior and anterior pedicles. The proximal end of the second metacarpal was disarticulated from the carpus and transplanted to the trapezium to form the new joint. With it was taken the lower 3 inches of the tendon of the extensor carpi radialis longus, and this was passed through drill holes in the trapezium and met-

carpal so as to encircle the joint and to stabilize it against dislocating. The upper or muscle end of this same tendon was fastened in the forearm to the extensor carpi radialis brevis tendon for added strength of extension of the hand. The surface of the second metacarpal is well adapted to rest on the saddle of the trapezium and in the correct rotation for opposition.

The original three extensor tendons of the thumb were united to their respective sides at the base of the transplanted metacarpal by passing the sutures through a drill hole in this bone. Good osteoperiosteal and tendon contact was established. The original flexor tendon of the thumb was dissected out and united to the two flexor tendons of the index finger so as to give added strength of flexion to the new thumb.

In the transplantation of the index finger the volar digital nerve to the second interdigital cleft was slit longitudinally up to the base of the palm, so that sensation would be preserved both on the radial side of the long finger and the ulnar side of the index finger. The fork of the volar artery to this cleft was cut and ligated on the long finger side to give richer blood supply to the new thumb. The posterior interosseous muscles in the first and second cleft were preserved with their same attachments and the anterior interosseous muscle in the second cleft was also preserved with its attachment. All the small thenar muscles were dissected out and attached to the metacarpal of the new thumb.

The new thumb was completely enclosed in skin by the flaps from the dorsum and palm of the hand. Eventually there was a denuded area about 1 inch wide and 5½ inches long running obliquely across the dorsum of the hand through the newly constructed cleft and around across the palm. This was filled in with a whole thickness Wolfe graft taken from the skin of the abdomen. Rubber sponge pressure was used in the dressing.

Result. The action of the wrist and remaining three fingers is normal. The newly constructed thumb has movement. It can touch the full length of the long finger and the base and tip of the ring finger. It can spread 1½ inches from the base of the long finger and makes possible an open grasp. It has the ability to oppose the other fingers, in that patient can place the thumb in a position forward from the hand in grasping. It adducts to the center line of the long finger.

The thumb has two movable and stable joints, a metacarpotrapezial and a distal joint. The latter, which formerly was the proximal joint of the index finger, has 25 degrees of motion and is in a functionating position. The thumb is exceedingly strong in all its movements, as it has the combined strength of the index finger and thumb, thus having eight functionating tendons instead of the normal four. It is also controlled in its movements by the thenar muscles attached to its metacarpal and functioning.

A feature of great importance is that the new thumb has natural sensation and vascularity, as the nerves and blood vessels have been transplanted with it. With the faculty of stereognosis it is most valuable to the patient in his work. The hand is covered with good skin throughout, is free from deforming cicatrices, and is painless. Patient is now again able to pursue his trade of carpentry.

A brief review of the methods that have been used in reconstructing thumbs follows:

In cases in which the metacarpal remains, a deep cleft has been established between the thumb and the second metacarpal—phalangization—(Huguier in 1852; Verrall; Arana; Perthes). The metacarpal, but not the carpal origin of the two adductor muscles of the thenar eminence, must be detached and the lining of the cleft is made by swinging skin flaps into it, or by supplying skin from elsewhere as practiced by Thiersch and Wolfe or by supplying pedicle grafts. The cleft has been further widened by removing the second metacarpal (Perthes, in a girl who lost five digits).

The index or long fingers together with a part or the whole of the metacarpal have been transplanted to the stump of the metacarpal of the thumb or to the trapezium, but without conservation of all nerves, tendons, and muscles (Perthes; Verrall, two cases in 1919, no joining of tendons or nerves; Dunlop, in 1923 used pedicle skin from abdomen for the cleft; Huguier).

The little finger (Wierzejewski) and the index finger have been rotated by means of osteotomy through the metacarpal into a position to oppose the thumb or the hand, or to oppose each other (Lauenstein, 1880; Perthes).

In cases of loss of index and long fingers the thumb has been made to approximate the little finger by altering the direction of its metacarpal and deepening the cleft (Klapp, 1912; Lyle).

Transplantations of new digits from a distance to substitute for a thumb have been made from the ring finger of the other hand and from the second toe (Nicoladoni, 1898, tendon function retained; Joyce, 1917, two cases from ring finger; von Eiselsberg; Krause; Klimm; etc. The method was condemned by Moreston at the International Surgical Congress, New York, 1914).

New thumbs have been made from pedicle skin grafts, tubular or not, from the abdomen and stiffened by a bone graft from the tibia, contacted to or driven into the carpus (Nicoladoni, 1897; Schepelmann; Ritter; Payre; Albee; Pierce).

In case of loss of the fingers, a digit or post for the thumb to work against has been reconstructed on the stump of the hand by the pedicle skin graft and bone graft method (Albee, 1919, two cases, skin flap from shoulder with part of clavicle, flap from chest, and bone from tibia).

In total loss of the hand an offset was reconstructed on the side of the radius which worked against the ulna by the motion of pronation (Henry, 1928). Also a cleft has been made between the radius and ulna, so these units could work against each other by their own muscles in a pincher action like the mouth of a crocodile (Krukenberg).

BIBLIOGRAPHY

ALBEE, F. Orthopædic and Reconstruction Surgery. p. 1015. Philadelphia: W. B. Saunders Co., 1919. Synthetic transplantation of tissue to form a new finger with restoration of the function of the hand. Ann. Surg., 1919, lxix, 379.

ARANA, G. B. Phalangization of the first metacarpal. Surg., Gynec. & Obst., 1925, xl, 859.

ARLT, B. R. Daumenplastik. Wien. klin. Wchnschr., 1917, xxx, 15.

BUNNELL, STERLING. Reconstructive surgery of the hand. 1924, xxxix, 259.

DUNLOP, J. The use of the index finger for the thumb: some interesting points in hand surgery. J. Bone & Joint Surg., 1923, January, 99.

HUECK, H. Ein Fall von Daumenersatz durch einen unbrauchbaren Finger. Deutsche Ztsch. f. Chir., 1920, cliii, 321.

HUGUIER. Arch. gén. de méd., 1874, i, 78.

JEPSON, P. N. Transformation of middle finger into a thumb. Minnesota Med., 1925, viii.

JOYCE, J. L. A new operation for the substitution of a thumb. Brit. J. Surg., 1918, v, 499. The results of a new operation for the substitution of a thumb. Ibid., 1929, xvi, 362.

LAMBERT, O. Resultat eloigne d'une Transplantation du gros Orteil en Remplacement du Pouce. Bull. et mém. Soc. de chir., 1920, xlvi, 689.

LENORMANT, C. Le traitement des mutilations des doigts et en particuleur du pouce par les autoplasties et transplantations. Presse méd., 1920, p. 223.

LYLE, H. H. M. The formation of a new thumb by Klapp's method. Ann. Surg., 1914, lix, 767. Deformity of the hand—formation of a new thumb from stump of first metacarpus. Ibid., 1921, lxxiv, 120. Formation of thumb from first metacarpus. Ibid., 1922, lxxvi, 121. Treatment of disabilities of the hand. Ibid., 1923, lxxviii, 816.

MACHOL. Beitrag zur Daumenplastik. Beitr. z. klin. Chir., 1919, cxiv, 181.

MANASSE, P. Vorstellung eines Falles mit Daumenersatz und Fingerauswechselung. Berl. klin. Wchnschr., 1919, lvi, 717.

MUELLER, W. Anatomische Studien zur Frage des Daumenersatzes. Beitr. z. klin. Chir., 1920, cxx, 595.

NICOLADONI, C. Daumenplastik und organischer Ersatz der Fingerspitze (Anticheiroplastik und Dactylo-plastik). Arch. f. klin. Chir., 1900, lxv, 606. Weitere Erfahrungen ueber Daumenplastik. Ibid., 1900, lxv, 695.

NUZZI, O. Intermetacarpolisi distali chirurgica. Riforma med., 1921, xxxvii, 248.

OMBREDANNE, M. L. Constitution autoplastique d'une Pouce prenant au moyen du Ier Metacarpien. Bull. et mém. Soc. de chir. de Par., 1920, xlvi, 158.

PERTHES, V. Ueber plastischen Daumenersatz insbesondere bei Verlust des ganzen Daumenstrahles. Arch. f. orthop. u. Unfall., 1921, xix, 198.

PIERCE, G. W. Reconstruction of the thumb after total loss. Surg., Gynec. & Obst., 1927, xlv, 825.

PIERI, G. Chir. d. organi. di movemento., 1919, iii, 325.

SCHEPELMANN, E. Das spaetere Schicksal einer Daumenplastik. Ztschr. f. orthop. Chir., 1919, xxxix, 181.

SCHMIEDT, W. Beitrag zur Daumenplastik. Deutsche. Ztschr. f. Chir., 1916, cxlv, 420.

SPENCER, W. G. Plastic operations on the thumb. Med. Sc. Abst. & Rev., 1920, iii, 29.

VERRALL, P. J. Three cases of reconstruction of the thumb. Brit. M. J., 1919, ii, 775.

CARCINOMA OF THE CERVIX

A Study of Cases Treated at the Free Hospital for Women between 1875 and 1929

MARSHALL K. BARTLETT, M.D., and GEORGE VAN S. SMITH, M.D., Boston

THE object of this study was to determine the results of treatment of patients suffering from carcinoma of the uterine cervix, correlating the type of treatment and the stage of the disease when seen. A minimum of attention has been given to age, symptoms, and past and family histories. These factors have been thoroughly treated in previous papers and an analysis of these factors in this series would add little to generally accepted statistics.

Between November, 1875, and January, 1929, 673 cases of carcinoma of the cervix were seen in this hospital and in the private practices of William P. Graves and Frank A. Pemberton. The division of this series into groups according to methods of treatment is shown in Table I.

TABLE I.—CARCINOMA OF THE CERVIX

Method of treatment	Cases
Radium alone	289
Complete hysterectomy	114
Complete hysterectomy followed by radium	45
Radium followed by complete hysterectomy	10
Vaginal hysterectomy	14
Palliative supravaginal hysterectomy	2
Palliative supravaginal hysterectomy followed by radium	2
Radium followed by palliative supravaginal hysterectomy	1
Radical excision of cervical stump	4
Radium followed by radical excision of cervix	2
Amputation of cervix	21
Amputation of cervix followed by radium	2
Curette and cautery	121
No treatment	46
Total	673

In the subdivision shown in Table I, cases listed as "complete hysterectomy" include both Wertheim hysterectomies and those described as simple complete hysterectomies. A review of the operative descriptions in these cases seemed to make this distinction entirely artificial in many cases, and it was finally discarded entirely.

For the purpose of classifying our results, patients in this series have been divided into 7, 5, and 3 year groups. The 7 year group includes all cases treated at least 7 years previous to this writing who are traceable 7 years or more, or until death. Similarly, the 5 year group includes all cases treated before January, 1925, who can be traced at least 5 years. The 3 year group comprises cases treated previous to January, 1927, and traceable 3 years or more. No gross statistics for the entire series have been calculated, as figures on a heterogeneous group treated by various types of procedure, both obsolete and modern, seem quite misleading.

The classification of the American College of Surgeons has been followed in grouping cases according to the stage of the disease.

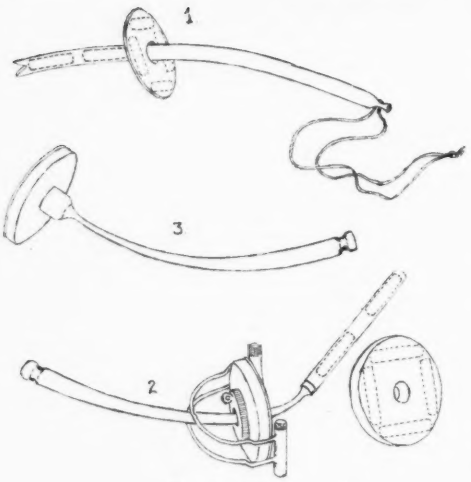
A. Disease limited to cervix,
B. Disease involving cavity or vaginal wall,
C. Disease involving broad ligaments,
D. Wide fixation. Remote metastases.

1. Primary case,
2. Recurrence in vaginal wall following panhysterectomy or radium for cancer,
3. Recurrence deep in pelvis following panhysterectomy,
4. Carcinoma of cervix following supracervical hysterectomy for carcinoma of the cervix.

Radium, first used in this hospital in 1916, is in the form of a salt, the bromide. This is in glass capsules enclosed in silver capsules 0.5 millimeter in thickness. The usual dosage in carcinoma of the cervix is 200 or 225 milligrams for 24 hours. The dosage has been varied from 100 to 225 milligrams for from 2 to 36 hours. More than 100 milligrams have not been left *in situ* for more than 30 hours.

The original method of application was to place part of the radium, usually 100 milligrams, into a rubber tube which was inserted into the cervical canal. The remainder of the radium was applied to a silver dollar or a fifty-cent piece through which a hole had previously been drilled to admit the passage of the rubber tube. The disc was then covered with rubber dam, slipped over the rubber tube, and its radium brought into close contact with the diseased cervix. This form of applicator is illustrated (Fig. 1).

A more recent method of application is by use of the Smith applicators (Figs. 2 and 3), which are made entirely of brass 1 millimeter in thickness. The tube is mounted on a flexible copper handle and fits into the cervical canal. The pill-box, of either a dollar or fifty-cent size, slips over the handle and comes to rest against the cervix. The pinwheel applicator, in either its two or four winged form, is occasionally used to gain greater radiation to the parametria or vaginal fornices.



Figs. 1, 2, and 3.

Recently the entire applicator has been coated with paraffin before insertion into the patient, to eliminate secondary beta radiation from the brass containers.

In preparation for the application of radium, when there is an excessive amount of malignant tissue present, a curettage and cauterization is performed. No hesitancy is felt at this hospital in undertaking this procedure, as careful analysis of cases with and without curettage and cauterization before radiation has failed to reveal any appreciable difference either in convalescence or in duration of life after operation. This is usually done from 10 days to 2 weeks before the application of radium. All curettings are, of course, examined microscopically to establish the diagnosis. In cases in which there is no gross excess of malignant tissue, previous curettage and cauterization is not done. In these cases careful biopsy is always done at the time of radium application.

No family history was available on the 85 private cases in this series. Of the remaining 588 patients, 61, or 10.4 per cent, gave a family history of malignant disease.

Forty-seven married patients and 25 single patients gave no history of pregnancy, a total of 10.7 per cent of the entire series. An additional 33, or 4.9 per cent, gave a history of abortions and miscarriages, but no full term pregnancy.

Previous supravaginal hysterectomy had been performed on 27 patients in this series. Eight of these cases are judged to have had carcinoma of the cervix at the time hysterectomy was performed. Thus cancer was probably present in 29.6 per cent of these cases at the previous operation. Eleven of the above 27 patients were operated upon in this hospital. Of these, one probably had cervical carcinoma at the time of operation.

To reduce this incidence of undetected early carcinoma, it is necessary to make a careful routine microscopic examination of all cervical curettings and trachelorrhaphy specimens. This is done at this hospital and 16 cases of early unsuspected cervical cancer have been detected. These patients were all treated with radium, with one exception. All but 2 of them are alive and well, the postradiation interval varying from a few months to 10 years. Of the two who are dead, one was a Class D case when she finally received radium 4 years after the original trachelorrhaphy specimen was removed. She survived radiation 2 months. The other received radium 1 year and 2 months after biopsy, was classified as Group B at that time, and survived only 4 months. One case had a complete hysterectomy and is well 10 years after operation.

Cauterization of the cervix, as done at this hospital, seems to be a fairly sure prophylaxis against later carcinoma. Approximately 1,700 cervices were cauterized between 1914 and January, 1929. No one of these patients is known to have later developed carcinoma of the cervix. A history of previous cauterization was obtained in only 1 of the 673 cases in this series. This one patient had had a cauterization done 5 months before complete hysterectomy for carcinoma of the cervix was performed. Judging from the condition at operation, the malignancy was probably present at the time of the cauterization.

In 560 of the cases in this series, the diagnosis of carcinoma was established microscopically. The remaining 113 were clinically unmistakable. Of these, 84 were seen previous to 1902, when microscopic examination was not a routine procedure.

On microscopic examination, 494 were classified as squamous and 66 as adenocarcinoma, a ratio of 7.5 to 1.

Pyometra was found as a complicating factor in 19 cases. In 17 of these cases, however, the condition was present at the first operation, constituting a complication of the disease rather than of the treatment. Stenosis of the cervix, following radium treatment, with consequent pyometra was the condition found in the 2 other cases. This was found at a second operation with application of radium for recurrence, 3 and 9 months after the first radiation. Of the 289 cases treated by radium, only these 2, or 0.69 per cent, developed pyometra.

There were 26 operative deaths in this series, as shown in Table II.

TABLE II.—OPERATIVE DEATHS

Operation	Total	Deaths	Per cent
Curettage and cauterization	121	5	4.1
Amputation of cervix	23	1	4.3
Radical excision of cervical stump	4	1	25.0
Complete hysterectomy			
1. Before 1902	14	9	64.3
2. 1902–1929	155	10	6.5
3. Total	169	19	11.2

The figure of 11.2 per cent for operative mortality for abdominal hysterectomy in this series is considerably lower than that given by Lane-Claypon, in a review of the existing literature on this subject, published in 1927. She found the total operative mortality 17.3 per cent for this operation on 11,880 cases.

RESULTS

Radium alone. The results of treatment of carcinoma of the cervix by radium alone are shown in Table III. The cases are divided into 3, 5, and 7 year groups as described above.

TABLE III.—RADIUM ALONE

	Class				
Group	A	B	C	D	Total
Traceable 7 years	2	6	41	42	91
7 year Survivals	2	0	1	1	4
Survival, per cent	100	0	2.4	2.4	4.4
Traceable 5 years	5	11	69	58	143
5 year Survivals	4	3	8	2	17
Survival, per cent	80	27.3	11.6	3.5	11.9
Traceable 3 years	18	15	100	82	215
3 year Survivals	16	9	23	6	54
Survival, per cent	88.9	60	23	7.3	25.1
Traceable 0–3 years	15	2	24	20	61
Survivals	15	1	20	11	47
Survival, per cent	100	50	83.3	55	77

Complete hysterectomy. The results of cases treated by complete hysterectomy are shown in Table IV.

TABLE IV.—COMPLETE HYSTERECTOMY

	Class				
Group	A	B	C	D	Total
Traceable 7 years	28	4	35	13	80
7 year Survivals	16	0	1	1	18
Survival, per cent	57.1	0	2.9	7.7	22.5
Traceable 5 years	35	4	36	14	89
5 year Survivals	26	0	2	1	29
Survival, per cent	74.3	0	5.6	7.1	32.6
Traceable 3 years	46	6	37	14	103
3 year Survivals	41	1	3	2	47
Survival, per cent	89.1	16.7	8.1	14.3	45.6
Traceable 0–3 years	5	0	5	0	10
Survivals	5	0	0	0	5
Survival, per cent	100	....	0	....	50

Complete hysterectomy followed by radium. The results of cases treated by this method are shown in Table V.

TABLE V.—COMPLETE HYSTERECTOMY FOLLOWED BY RADIUM

	Class				
Group	A	B	C	D	Total
Traceable 7 years	4	4	16	4	28
7 year Survivals	2	2	4	0	8
Survival, per cent	50	50	25	0	28.6
Traceable 5 years	9	4	21	4	38
5 year Survivals	4	2	6	0	12
Survival, per cent	44.4	50	28.6	0	31.6
Traceable 3 years	9	5	21	4	39
3 year Survivals	7	2	8	0	17
Survival, per cent	77.8	40	38.1	0	43.6
Traceable 0–3 years	0	0	1	0	1
Survivals	0	0	0	0	0
Survival, per cent	....	..	0	..	0

Radium followed by complete hysterectomy. Ten cases were treated by this method, all more than 7 years previous to January, 1929. Six of these died less than 3 years after operation. Of these, 5 were Class C and the other Class D at the time of operation. Two Class A cases and one Class C patient survived the 3 year interval, 30 per cent. One Class A and one Class C case survived 5 years, 20 per cent. One case when last heard from was living, less than 3 years after operation.

Gross figures for complete hysterectomy and radium. Combining the four preceding groups into one to give the results in cases treated by radium or complete hysterectomy, we obtain the figures shown in Table VI.

TABLE VI.—RADIUM OR HYSTERECTOMY OR BOTH

Group	Total
Traceable 7 years	208
7 year Survivals	30
Survival, per cent	14.4
Traceable 5 years	279
5 year Survivals	60
Survival, per cent	21.5
Traceable 3 years	366
3 year Survivals	121
Survival, per cent	33.1
Traceable 0–3 years	73
Survivals	53
Survival, per cent	72.6

RADIUM VERSUS HYSTERECTOMY

It is generally conceded that in any but very early cases of carcinoma of the cervix radium is preferable to surgical excision as a method of treatment. The operative mortality must always be kept in mind in comparing these two groups. As shown, the operative deaths associated with complete hysterectomy in this series were 11.2 per cent. Excluding cases previous to 1902, the operative mortality was 6.5 per cent for this operation.

Radium for carcinoma of the cervix in this hospital is practically always applied under ether anæsthesia. In this series 289 cases were treated

by radium alone. Not one operative death occurred in this group.

In view of the foregoing it is interesting to tabulate once more the comparative results of radium and complete hysterectomy. These figures include operative deaths.

TABLE VII.—RADIUM AND COMPLETE HYSTERECTOMY

Group	Radium	Complete hysterectomy
Traceable 7 years	91	80
Survival, per cent	4.4	22.5
Traceable 5 years	143	89
Survival, per cent	11.9	32.6
Traceable 3 years	215	103
Survival, per cent	25.1	45.6

It is interesting to compare these figures with those given by Lane-Claypon for 5 year survivals. In her analysis patients dying of causes other than cancer are deducted from the series. In computing our figures we have considered all deaths as due to carcinoma.

Lane-Claypon gives 18.3 per cent 5 year survivals of patients treated by abdominal hysterectomy, as compared with 32.6 per cent in this series. She found 22 per cent 5 year survivals after radiation. In this series 11.9 per cent passed the 5 year interval after radium treatment. Of the cases of carcinoma of the cervix treated at the Mayo Clinic, by radium and X-ray, between 1915 and 1924, 23.15 per cent survived the 5 year interval. Selecting from the above group the early, or Class A, cases and tabulating them, the comparison shown in Table VIII is obtained.

TABLE VIII.—CLASS A, EARLY, CASES

Group	Radium	Complete hysterectomy
Traceable 7 years	2	28
Survival, per cent	100	57.1
Traceable 5 years	5	35
Survival, per cent	80	74.3
Traceable 3 years	18	46
Survival, per cent	88.9	89.1

The question of late recurrences after radium treatment or hysterectomy is an interesting one. It is generally thought that late recurrence is more prone to occur following radium than after complete hysterectomy. One explanation offered is that the so-called late recurrence after radium is not a recurrence of the original cancer but a new neoplasm, a result ofthe radiation.

Here again, the results of this analysis seem at variance with the usual concepts. Fifty-two Class A cases had complete hysterectomies. Of these, 35 were traceable for 5 years and 28 for 7 years or longer. Four known late recurrences were found. The postoperative intervals were 5, 5, 8, and 11 years in these 4 cases. Of the 33 Class A cases treated by radium, 5 were traceable for 5 years but only 2 for 7 or more years. None of these cases has developed recurrence as yet.

Vaginal hysterectomy for carcinoma of the cervix has not been done in this hospital since 1900: there were 11 traceable cases in this group. Nine patients died 8 months or less after operation, 2 being operative deaths. Two were living with recurrence 4 and 7 months after operation, while one, a Class A case, was living and well 11 years and 5 months after operation.

Palliative supravaginal hysterectomy. The palliative supravaginal hysterectomy was performed in 2 Class D cases. One survived 2 years and 8 months and the other died 4 years after operation.

Palliative supravaginal hysterectomy and radium. Palliative supravaginal hysterectomy followed by radium was the treatment of 2 cases. One died 11 months after operation and the other was living with recurrence 2 years after operation. These cases were both graded as Class C at operation.

This same combination of treatment, in reverse order, was used on one Class C patient. She died 1 year, 5 months after operation.

Radical excision of the cervical stump for carcinoma of the cervix after supravaginal hysterectomy was performed on six cases. One is untraceable. One, Class 4 D, died 5 months after operation. Radium was combined with the surgical procedure in these 2 cases. The 4 others were Class 4 A. There was one operative death. One died 1 year, 3 months after operation, and the 2 others are well 3 years, 6 months, and 5 years, 6 months after operation.

Amputation of the cervix. Five Class A patients received this form of treatment, all previous to 1910. Three died 13, 19, and 27 years after operation respectively. Two are living 24 and 41 years after operation.

Of the 2 Class B cases so treated, 1 died 1 year, 2 months, and 1 is living 22 years after operation. Biopsy had been performed on these cases with long survival intervals.

There were 12 Class C patients treated by this method. Three are untraceable. There was 1 operative death. Four died from 7 months to 2 years, 11 months after operation. Four were living when last traced, the longest period after operation being 1 year, 3 months.

Two Class D patients were treated. One is untraceable and the other died 1 year, 6 months after operation.

Amputation of the cervix followed by radium was the procedure in 2 cases. One patient, Class A,

was living and well 1 year, 4 months after operation when last heard from. The other, a Class C case, died 2 years, 3 months after operation.

Curette and cautery. Curettage and cauterization was used as a palliative measure in this hospital before the advent of radium. One hundred and twenty-one patients received this treatment. This does not include those cases in which this procedure was carried out as a preliminary to radiation. The results of this group are here shown in Table IX. There were no Class A cases in the group. All the living patients had recurrence at last examination.

TABLE IX.—CURETTAGE AND CAUTERIZATION

	B	C	D
Untraceable	0	5	19
Living with recurrence			
Postoperative interval 0 to 1 year	1	3	0
1 to 2 years	0	1	0
Died			
Postoperative interval 0 to 1 year	0	18	50
1 to 2 years	0	13	3
2 to 3 years	0	3	0
3 to 5 years	0	3	1
5 to 7 years	0	1	0
7+ years	0	1	0
	1	47	73

No treatment. Forty-six patients were discharged from the hospital without treatment, some refusing operation and others being inoperable. Four were Class A cases. Of these, one is untraceable; the 3 others died 11 months, 1 year and 10 months, and 2 years and 8 months after examination, respectively. Two Class B cases were seen but neither is traceable. Of the 19 Class C patients, 8 are untraceable, 10 died less than 1 year after discharge from the hospital and the 1 other patient died between 1 and 2 years after examination. Twenty-one Class D cases were seen: 3 are untraceable; 17 died less than a year after they were first seen; the 1 remaining patient survived the 1 year interval by 4 months.

SUMMARY AND CONCLUSIONS

1. Six hundred and seventy-three cases of carcinoma of the cervix treated at the Free Hospital for Women and by W. P. Graves and F. A. Pemberton in their private practices have been studied.

2. Methods of radium application, as used in this hospital, have been described and illustrated.

3. Preliminary curettage and cauterization, to remove excess malignant tissue, is practiced when necessary and is not detrimental to the postoperative progress of the patient.

4. Of 588 patients on whom a family history was available, 10.4 per cent gave a history of malignant disease.

5. In this series, 10.7 per cent of the patients gave a history of no pregnancy. An additional 4.9 per cent gave a history of abortions or miscarriages but no full term pregnancy.

6. Twenty-seven cases had had previous supravaginal hysterectomy. Of these, 29.6 per cent probably had cancer at the time hysterectomy was performed. Careful biopsy at that time might have revealed the presence of the disease and led to earlier treatment of the carcinoma.

7. Routine microscopic examination of curettings and trachelorrhaphy specimens at this hospital has led to the detection of 16 early cases of carcinoma of the cervix, grossly unsuspected.

8. Approximately 1,700 cervices were cauterized in this hospital, between 1914 and January, 1929. No one of these patients is known to have developed cervical carcinoma. Deep radial cauterization with the actual cautery is practiced and is fairly sure prophylaxis against malignancy.

9. A history of cauterization of the cervix was given by only one patient in this series. This was done only 5 months before the malignancy was discovered, and carcinoma was probably present at that time.

10. The incidence of squamous carcinoma exceeded that of adenocarcinoma by a ratio of 7.5 to 1.

11. Pyometra was encountered as a complication in 19 cases. In only 2 of these, however, was the pyometra secondary to radium therapy with subsequent stenosis of the cervix. This is an incidence of only 0.69 per cent in cases treated by radium.

12. The operative mortality for complete hysterectomy was 11.2 per cent. Calculating for the years 1902 to 1930, the operative mortality was 6.5 per cent. No operative deaths occurred following radium application, although usually done under ether anæsthesia.

13. The results of the various types of treatment have been presented, correlating the stage of the disease and the postoperative survival.

14. Contrary to the usual expectation, the results from complete hysterectomy are rather better than those from radiation, in this series.

15. Late recurrences, as encountered in these patients, seem more prone to occur after hysterectomy than following radium therapy.

The writers wish to thank Dr. W. P. Graves and Dr. F. A. Pemberton for their interest and co-operation in the study of their private cases and Dr. O. Watkins for making drawings of the radium applicators.

REFERENCES

1. Bowing, Harry H., and Fricke, Robert E. Treatment of carcinoma of the cervix uteri with radium and roentgen rays from 1915 to 1924. Radiol., 1930, xiv, 211.
2. Lane-Claypon, Janet E. Cancer of the Uterus, 1927.

EXCRETION PYELOGRAPHY WITH ABRODIL

PRIVATDOZENT DR. H. BRONNER, AND DR. J. SCHUELLER, COLOGNE, GERMANY
From the University Surgical Clinic, Buergershospital, Cologne

THE idea of introducing a shadow-producing substance into the blood stream so that roentgenograms can be taken of the pelvis of the kidney and of the ureters is an old one; it is true, however, that the early attempts to do this secured satisfactory pictures in only a very limited number of cases. This procedure was studied in America by Osborn, Sutherland, Rowntree and Scholl among others, and in Germany by von Lichtenberg and Rosenstein and Volkmann. Some of these men were successful occasionally in producing useful pictures. On the whole, however, it cannot be said that any of the methods were clinically useful.

It remained for Roseno to change this state of affairs. In his study at the Frangenheim Clinic in Cologne, he made intravenous injections of a compound of sodium iodide and urea (pyelognost), and was the first to succeed in obtaining consistently good pictures. Roseno's method had a disadvantage, however, in that the substance he used was not as neutral as is desirable to insure a harmless clinical method of examination.

Soon after Roseno's work Swick and von Lichtenberg introduced uroselectan in the clinic. This product makes possible the production of good photographs without producing serious by-effects.

We wish to report here on a further preparation, called abrodil, for the intravenous demonstration of the ureters. After extensive preliminary pharmacological tests,[1] a short report of which will be found below, we began the use of abrodil in the Frangenheim Clinic and so far in a series of 100 cases we have found the product to be most reliable.

EXPERIMENTAL CONSIDERATIONS

Abrodil is a white crystalline powder and is the sodium salt of iodo-methane-sulphonic acid (ICH_2SO_3Na). Its molecular weight is 244 and it contains 52 per cent of iodine. This iodine is very firmly organically bound. Abrodil is soluble to the amount of 70 per cent in water at room temperature with a neutral reaction. The solution can be sterilized and kept without danger of decomposing.

A 4 per cent solution of abrodil is isotonic with the blood ($\Delta = 0.58$ degrees) and there is no hæmolysis of the erythrocytes suspended in it.

Mice tolerate up to 6 grams (90 grains) of abrodil per kilogram ($2^1/_5$ pounds) in a 30 per cent solution and above 7.5 grams (125 grains) per kilogram in a 15 per cent solution, while 1.8 grams (27 grains) of common salt per kilogram in a 7.2 per cent solution are generally lethal, and sodium iodide to the extent of 1 gram (15 grains) per kilogram in a 20 per cent solution leads to death in a number of cases.

In 10 rabbits, 1 gram (15 grains) abrodil per kilogram proved quite harmless and 2 grams (30 grains) per kilogram in a 10 to 40 per cent solution were tolerated without symptoms. It was not until the higher doses were given that distinct effects were produced probably through osmosis. Thus one rabbit given an injection which took 2 minutes, of 2.4 grams (36 grains) per kilogram in a 10 per cent solution, died of acute pulmonary œdema, while another animal which received 6 hourly doses of 1 gram (15 grains) each per kilogram, i.e., a total of 6 grams (90 grains) per kilogram given intravenously, showed no symptoms whatever of poisoning during 7 days' observation.

In the case of dogs, 2 grams (30 grains) per kilogram in a 20 per cent solution intravenously were always quite harmless.

The fact that following even the largest doses the urine of rabbits, cats, and dogs is always free from inorganic iodine proves that abrodil is excreted by the kidneys without the splitting off of inorganic iodine.

The rate of excretion is very high. In the case of a dog weighing 15 kilograms (33 pounds) which received 10 grams ($2^1/_2$ drachms) of abrodil intravenously and the excretion of which by the urine was quantitatively measured, it was shown that after 1 hour, 47 per cent; after 3 hours, 76 per cent; after 9 hours, 89 per cent; and after 24 hours, 93 per cent of the total amount injected was excreted. The urine on the 2 subsequent days contained only 0.2 per cent of the total quantity. Taking into consideration, then, the unavoidable losses in such experiments, it may be assumed that practically all of the substance is excreted in 12 to 24 hours and that the preponderating share has left the body in 3 hours.

[1] Bronner, Hecht, Schueller. Excretion-pyelography with abrodil. Fortschr. a.d. Geb. Roentgenstrahl., 1930, Aug.

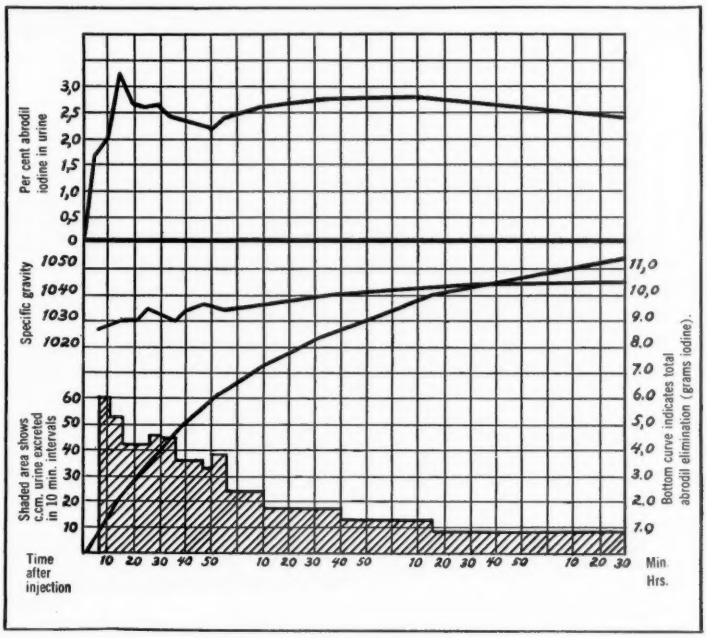


Fig. 1. Excretion of iodine after intravenous injection of 40 grams of abrodil.

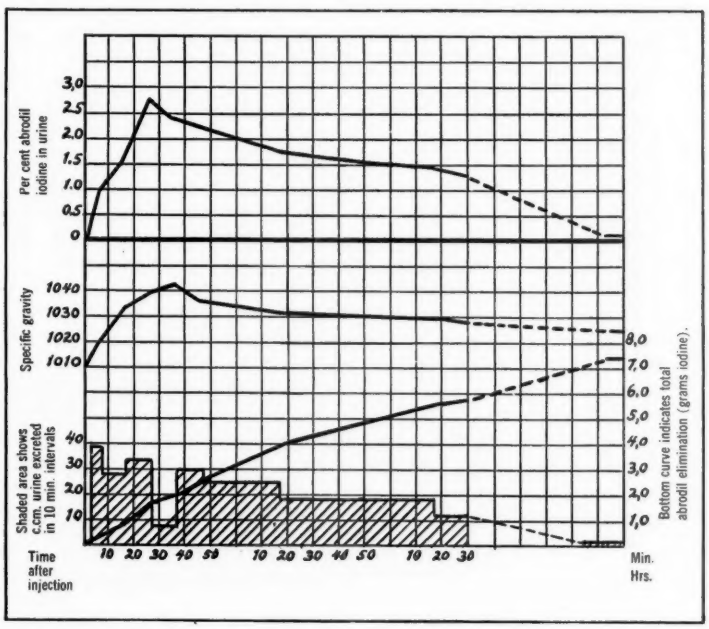


Fig. 2. Excretion of iodine after intravenous injection of 20 grams of abrodil.

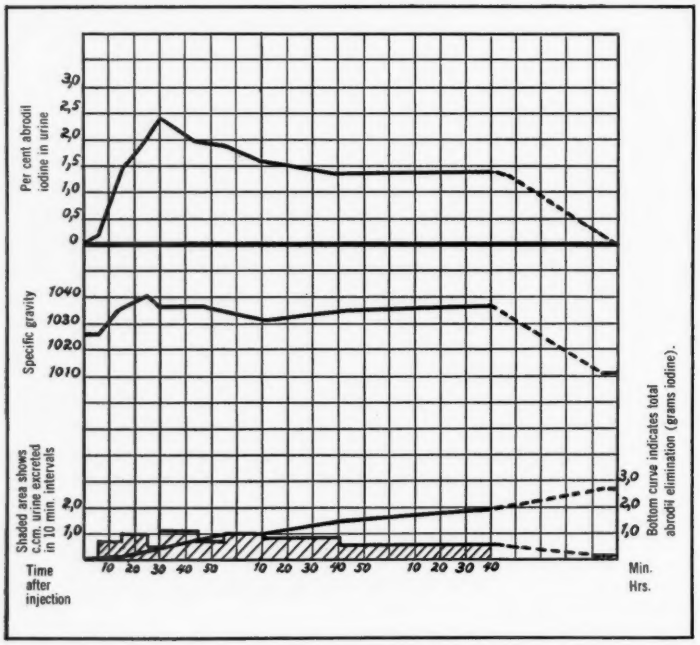


Fig. 3. Excretion of iodine after intravenous injection of 6 grams of abrodil. The upper curve shows the percentage of abrodil-iodine in the urine. The middle curve shows the specific gravity. The lower curve indicates the total abrodil elimination (grams iodine). The shaded area at bottom of chart indicates the cubic centimeters of urine output in 10 minute intervals.

Since the excretion of such large amounts of a substance foreign to the body imposes a heavy load on the kidneys, these organs were carefully tested and examined. The urine never contained any pathological constituents and the histological examination by Professor Domagk, of Elberfeld, showed that after very heavy doses, which never come in question for human beings, there were only very trifling, transient tubular changes such as swelling and fatty degeneration while in the glomeruli no changes whatever were observed.

CLINICAL APPLICATION OF ABRODIL

From these preliminary pharmacological tests, which show the harmlessness of abrodil as well as its efficient diuretic action, it seemed quite probable that abrodil would be well tolerated by human beings. Doses of 40 grams (about 1½ ounces) were used at first, but we reduced these later to 20 grams (¾ ounce). With these small doses of about 20 grams (¾ ounce) which at the moment we consider the standard dose for men, we have observed no secondary effects. A slight rush of blood to the head, a feeling of heat, slight nausea, and especially a strong feeling of thirst were symptoms which we noticed only now and then with the larger doses of 40 grams (1½ ounces); but all these by-effects have disappeared since we have been using doses of 20 grams (¾ ounce). The 20 grams of abrodil we inject in a 20 to 30 per cent solution into the median cephalic vein. Twenty grams of abrodil are dissolved in 70 to 100 of distilled water, the solution being filtered and sterilized. That the abrodil in this concentration causes practically no local reaction is shown by the fact that slight paravenous effusions cause no trouble with the exception of a brief burning pain. In only one instance in the 100 cases was the wall of the vein injured and in this patient a slight thrombophlebitis of the outflow vein was produced. We were naturally tempted to raise the strength of the abrodil solution so as to lessen the quantity of fluid to be injected, but we did not do so, since solutions of 40 to 50 per cent would be certain to cause more frequent osmotic thrombophlebitis. In proof of

Fig. 4. Normal. Nineteen minutes after injection of 20 grams of abrodil.

Fig. 5. Normal. Roentgenogram taken 14 minutes after the intravenous injection of 20 grams of abrodil solution.

this is the fact that, for example, we have succeeded in obliterating varicose veins with a 50 to 60 per cent solution of abrodil. In order to reduce the difficulty of injecting large amounts of fluid, it is advisable either to use a burette or an injection syringe provided with a piece of rubber tubing inserted between the needle and the syringe. The injection should then take 2 to 3 minutes, the solution being warmed to body heat. All our patients, with the exception of one wretched looking very uroseptic man who complained of headache and nausea for several hours after he had had 30 grams (1 ounce), were able to walk out of the X-ray room feeling very well. *Excretion-pyelography with abrodil is thus a method which can be carried out on ambulatory patients.* It appears to be contra-indicated only in those patients suffering from the severest form of kidney insufficiency, in which the heavy burden imposed on the kidneys even by common salt cannot be looked upon as a harmless procedure.

Since inorganic iodine is not split off within the body, the use of abrodil, even in the case of pregnant women and tuberculous patients is well borne. In human subjects solutions of abrodil also cause no damage to the kidneys.

When the kidneys were normal, examination for iodine in urine passed after an injection of abrodil disclosed that the urine in the bladder will have reached a 2 per cent content of iodine in from 5 to 25 minutes. The iodine curve remains then in most cases more or less above the 2 per cent limit. The duration of this excretion of iodine over the 2 per cent depends on the quantity of substance injected. The larger the dose the longer the kidneys continue to excrete a urine with this high percentage of iodine (Figs. 1 and 2). On the other hand a larger dose does not result in raising the height of the iodine curve to any extent. It makes little difference whether 10, 20, or 40 grams (⅓, ¾, or 1½ ounces) be injected, for the content of iodine in the urine, in spite of this, does not rise above 2 to 3 per cent. The highest content of iodine, which we have so far ascertained, was 3.25 per cent, a figure which appears to represent about the greatest capacity of a healthy kidney. As long as the kidneys

Fig. 6. Left ureteral stone (see arrow). Ten minutes after intravenous injection of 28 grams of abrodil. The calculus has caused obstruction of the upper ureter. The right side is normal.

Fig. 7. Destruction of right kidney and ureter by tuberculosis. Tuberculosis of bladder with vesico-ureteral reflux on the left. Twenty minutes after intravenous injection of 25 grams of abrodil.

excrete a urine having an iodine content of over 2 per cent, a good pyelographic picture may be expected.

To obtain a good pyelographic picture the *diuresis* (see the chart recording the amount of urine excreted), is important. The chart shows us that immediately after the injection of abrodil diuresis is increased but becomes less again after about ½ to 1 hour. From this it is plain that it is only during the first hour that the ureters are flushed by a large amount of this strongly iodized urine. At later periods, it is true that the percentage of iodine excreted may still be high, but the diuresis has already fallen off. It will, however, be easily understood that the best pyelographic pictures will be obtained at the period at which the percentage of excretion of iodine is high and diuresis is great. From the very first it has been our endeavor to reduce the amount of abrodil to the smallest possible limit, to keep down the cost of examination as far as we could on the one hand and to render it as harmless as possible for the patient on the other. There was, however, a limit to our endeavors inasmuch as doses under 10 grams (2½ drachms) caused such slight diuresis (Fig. 3), that the quality of the picture was affected. Thus with a dose of 6 grams (1½ drachms) the amount of urine excreted in the first half hour was 26 cubic centimeters and in the second half hour 24 cubic centimeters, while the corresponding figures after 20 grams were respectively 100 and 50 cubic centimeters and with 40 grams 200 and 90 cubic centimeters. It appears, therefore, that doses of less than 10 grams (2½ drachms) are not worth recommending, entirely apart from the fact that with these small doses, as already mentioned, the period during which excretion of iodine of over 2 per cent takes place, is greatly shortened (e. g. 10 grams, to 15 minutes; 20 grams, to 1 hour, and 40 grams to from 2½ to 4 hours).

Fig. 8. Pregnancy in ninth month. Twenty-four minutes after intravenous injection of 25 grams of abrodil. Breech presentation. Marked enlargement of the kidney pelvis and ureter.

Fig. 9. X-ray picture of pelvis of kidney with ureteral catheter in position. In the right ureter a 20 per cent solution of abrodil was injected and in the left a 30 per cent solution.

In our opinion the correct average is a dose of about 20 grams, because 40 grams places an unnecessary burden on the kidneys.

For further information as to the curve of excretion of iodine after single doses, we may refer the reader to our article in the August, 1930, issue of the *Fortschritte auf dem Gebiete der Roentgenstrahlen*.

Since abrodil has a 52 per cent iodine content, it is quite easy, merely by multiplying by 1.92, to find out the amount of substance excreted at any time. In this way it can be demonstrated that excretion is greatest during the first hour, and amounts to 25 to 40 per cent of the substance injected. The excretion curve of the substance then rises sharply and reaches 70 to 80 per cent between the fourth and fifth hours. The curve flattens out and after 24 hours about 90 per cent of the substance can be demonstrated in the urine.

From what has already been stated, the problem as to the most favorable moment for taking an X-ray photograph answers itself. Since maximum excretion occurs during the first hour, and moreover since during this period the highest iodine content of the urine and maximum diuresis coincide, the possibility of obtaining the best X-ray picture falls within this period. Since between 5 and 25 minutes after administration, diuresis is very marked and at the same time the iodine content has reached its highest point, a very good X-ray picture may be expected quite early, and practice has confirmed this view. In as short a period as 5 minutes after injection we have obtained excellent pictures of the whole pelvis of the kidney and ureters. Very often an X-ray picture taken between 15 and 20 minutes after injection was the best of the whole series. With doses of about 20 grams we have obtained good pyelograms up to the end of the second hour. With larger doses up to 40 grams which were given only at the commencement, a good picture could be obtained even in the third and

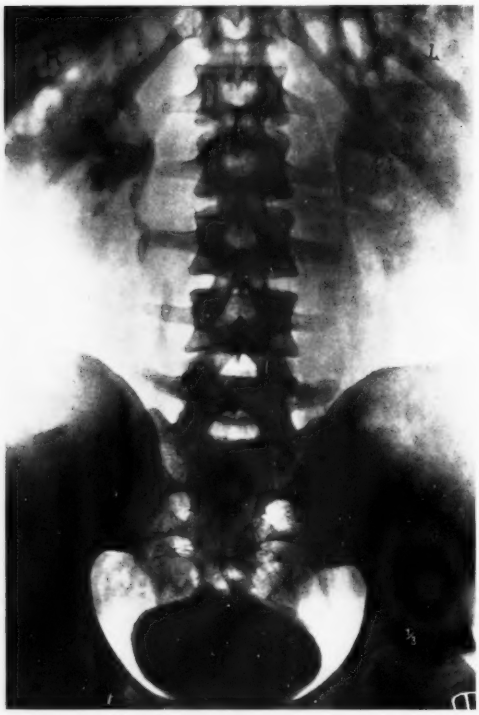


Fig. 10. Same patient as in Figure 9. Pyelogram for comparison. Forty minutes after injection of 20 grams of abrodil.

fourth hour after the injection, a period corresponding to that at which with a dose of 20 grams the picture became very shadowy or had disappeared altogether. All this discussion naturally refers only to persons with healthy kidneys or patients whose kidneys have a good capacity for excreting salts. In kidneys functionally very defective the result is different, for in these the commencement of the excretion is delayed and the period of total excretion is long drawn out. The maximum excretion may then be much later, and it is frequently not until the fifth to the tenth hour that a useful pyelogram can be obtained.

It was suggested that the use of the quantitative excretion of abrodil might be used as a test of the functional capacity of the kidneys. The quantitative determination, however, takes up considerable time and the results obtained, as far as our experience shows, are not more conclusive than other and more easily carried out kidney function tests. We, therefore, share Lichtwitz's view that from such excretion charts "nothing more or less can be deducted than facts concerning the conditions of excretion of the test substance."

Finally we wish to add some remarks on the use of solutions of abrodil for pyelography with the ureteral catheter. We know that the question of opaque X-ray substances for instrumental pyelography has not yet been ideally solved. It is true that solutions of bromide have long been used for this purpose, but the solutions of sodium iodide used in their place have left much to be desired. The solutions of abrodil possess all the advantages of solutions of sodium iodide, but have certain advantages over the latter inasmuch as they cause the very minimum of local irritation, practically no more than an equimolecular saline solution. Since iodine is not split off from abrodil, the solutions of it are free from the danger of iodism. Fresh solutions of abrodil are further compatible with solutions of mercury oxycyanate as well as a 1 per cent solution of silver nitrate, so that the employment of solutions of the former does not exclude the simultaneous use of the latter important urological antiseptics. We recommend a 15 to 20 per cent sterile solution of abrodil as sufficient for all purposes. It is only rarely necessary, especially in the case of corpulent persons, to increase the strength of the solution up to 30 per cent. None of these solutions, as far as our experience goes, cause any kind of subjective trouble.

A METHOD FOR THE PRE-OPERATIVE DETERMINATION OF THE BEST FUNCTIONAL POSITION FOR AN ANKYLOSED HIP

A PRELIMINARY REPORT[1]

ALFRED O. ADAMS, M.D., SPOKANE, WASHINGTON

A CAREFUL study of all cases of unilateral ankylosis of the hip that have been treated in the Shriners' Hospital for Crippled Children, has led to the conclusion that the best functional position for an ankylosed hip in a child is one of 20 to 25 degrees flexion, less than 18 degrees abduction, and slight external rotation of the extremity.

In a discussion of the operative procedures for stabilizing the hip, the question of position is usually dismissed with the statement that the extremity should be placed in a position of flexion and abduction; the degree of abduction being governed by the amount of shortening. Little emphasis is placed upon the exact degree of flexion and abduction that should be present. In cases I have had an opportunity to observe, there is a definite position for each individual which would give the best functional result and a few degrees variation in any direction may be of extreme importance.

It is the object of this paper to present a simple method whereby the operator may, before operation, determine the best position for the individual case under consideration. The subject is best described by separating it into the natural subdivisions of flexion, abduction, rotation, and apparent shortening.

FLEXION

The above statement that 20 to 25 degrees flexion offers the best functional result will probably meet with some disapproval, since it is less than the figures usually given. The cases that I have observed were all children under 17 years of age, who were leading an active life and were spending the usual amount of time in school. Those with 20 to 25 degrees flexion, provided the angle of abduction was correct, were able to walk with very little limp and could assume a very satisfactory sitting position (Fig. 6). There was not a single patient who complained of pain in the back after sitting. Most of these children could climb stairs in the normal manner, by giving a little jump when stepping up with the foot on the involved side. The only handicap that was generally experienced, was an inability to lace the shoe.

In those patients in which the degree of flexion was more than 25 degrees, a limp and lordosis became noticeable and in some there was a complaint of pain in the lumbar spine after walking.

In 1888 Kingsley described a method for determining the degree of flexion deformity of a hip which I have found to be more accurate and convenient than the use of a goniometer. He located a point on the lateral side of the extremity which was 24 inches from the trochanter (line $A\ B$, Fig. 1) and with the lumbar spine flat and the knee extended, he measured the distance of this point from the table (line $B\ C$). By referring to Table I, one readily finds the angle of flexion that corresponds to this measurement. A few of these measurements can be easily memorized so that it is not always necessary to have the table available.

ABDUCTION

The fact that abduction of a hip will decrease the apparent shortening of the lower extremity and that adduction will increase the apparent shortening is well understood. It is therefore evident that the degree of abduction must be governed solely by the amount of real shortening present.

The patients I have observed who have had the proper amount of flexion and an abduction of 18 degrees or less, walk with a very satisfactory gait when provided with a lift under the extremity that is one-half inch less than the apparent shortening present. In cases with the angle of abduction more than 18 degrees the compensatory scoliosis becomes very noticeable and the patient walks with the feet wide apart.

In 1888 Lovett published a method by which the degree of abduction or adduction of a hip could be determined if the difference between the real and apparent shortening and the width of the pelvis were known. I have found this method exceedingly useful and while the results check very closely with measurements taken with a goniometer, upon repeated examination they are more constant. When Lovett's table (Table II) is to be consulted, the measurements should be taken when the patient is lying on his back, with the head, chest, umbilicus, and feet in alignment and with the feet not more than 2 inches apart.

[1]From Shriners' Hospital for Crippled Children and Department of Surgery, Washington University Medical School, St. Louis, Missouri.

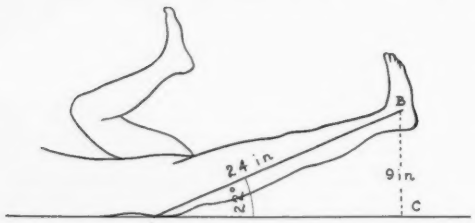


Fig. 1. Author's modification of Kingsley's method of measuring a patient in order to determine the degree of flexion of an ankylosed hip.

TABLE I.—FOR ESTIMATING THE DEGREE OF FLEXION

	Degrees		Degrees		Degrees		Degrees
0.5 inches	1	6.5 inches	16	12.5 inches	31	18.5 inches	50
1.0 inches	2	7.0 inches	17	13.0 inches	33	19.0 inches	52
1.5 inches	3	7.5 inches	19	13.5 inches	34	19.5 inches	54
2.0 inches	4	8.0 inches	20	14.0 inches	36	20.0 inches	56
2.5 inches	6	8.5 inches	21	14.5 inches	37	20.5 inches	58
3.0 inches	7	9.0 inches	22	15.0 inches	39	21.0 inches	60
3.5 inches	9	9.5 inches	24	15.5 inches	40	21.5 inches	63
4.0 inches	10	10.0 inches	25	16.0 inches	42	22.0 inches	67
4.5 inches	11	10.5 inches	27	16.5 inches	43	22.5 inches	70
5.0 inches	12	11.0 inches	28	17.0 inches	45	23.0 inches	75
5.5 inches	14	11.5 inches	29	17.5 inches	47	23.5 inches	80
6.0 inches	15	12.0 inches	30	18.0 inches	48	24.0 inches	90

If the feet are separated the apparent shortening is altered.

I have elected to measure from the umbilicus and anterior superior spine to the sole of the foot rather than to the internal malleolus. This point is selected on account of the marked difference in measurements from the internal malleolus to the sole of the foot on the two sides in cases in which there is considerable atrophy of the involved extremity. When the apparent shortening exceeds the real shortening, the extremity is adducted and if the real shortening exceeds the apparent shortening it is abducted.

Lovett's method for determining abduction or adduction cannot be used with the same accuracy in cases in which there is a marked knock-knee associated with an adducted hip. This condition is frequently seen, for in cases in which the hip is markedly adducted, a knock-knee is often a compensatory development. This deformity permits a lowering of the anterior superior spine which in turn results in a decrease in the apparent shortening. Therefore, the degree of adduction as determined by this table is less than that which actually exists.

I have attempted to measure accurately the angle of abduction or adduction of a hip on X-ray plates (Fig. 8), by drawing one line across the plate passing through the lowest points of the sacro-iliac joints and a second line superimposed on the femur and measuring the angle at which these lines cross with a protractor. The results obtained in this manner correspond very closely with those obtained by Lovett's method provided considerable care is taken at the time these plates are taken. The patient must be placed on the X-ray table with the pelvis level in both planes. This may be accomplished by elevating the extremity of the involved side to compensate for the amount of flexion present. The X-ray tube must be focused over the involved hip. If these precautions are not carried out, the angle of flexion that is present will result in an X-ray in which the amount of abduction will appear as increased. The X-ray, however, offers a valuable method for checking the other measurements.

ROTATION

The question of rotation offers little difficulty. It will suffice to say that the best position is one of slight external rotation. Internal rotation should be avoided.

APPARENT SHORTENING

Referring again to Lovett's table (Table II) it is apparent that in addition to the angle of abduction, the width of the pelvis is an important factor to consider. For example, 10 degrees abduction, when the pelvis measures 8½ inches, will compensate for 1½ inches shortening. The same degree of abduction, with a pelvis measuring 13 inches, will compensate for 2¼ inches; a difference of ¾ inch. Therefore, as the pelvis increases in width the apparent shortening will decrease, provided of course, the two extremities show the same rate of growth and it is reasonable to assume in these cases that, since only the upper femoral epiphysis is involved, the rate of growth of the two extremities would be practically the same. This is a point that deserves consideration, for cases in which there is an ankylosed hip in such a position as to result in some apparent lengthening usually present a very awkward gait.

AUTHOR'S METHOD

Since Abbott has developed an operation fo lengthening the lower extremity, two methods c compensating for shortening due to involvemer of the hip joint are now available; first, fixation c the hip in a position of abduction, and, secon lengthening of the extremity. Therefore, it no becomes essential that the operator be able t determine with a fair degree of accuracy, befo treatment is instituted, which of these method or if a combination of the two, is to be used.

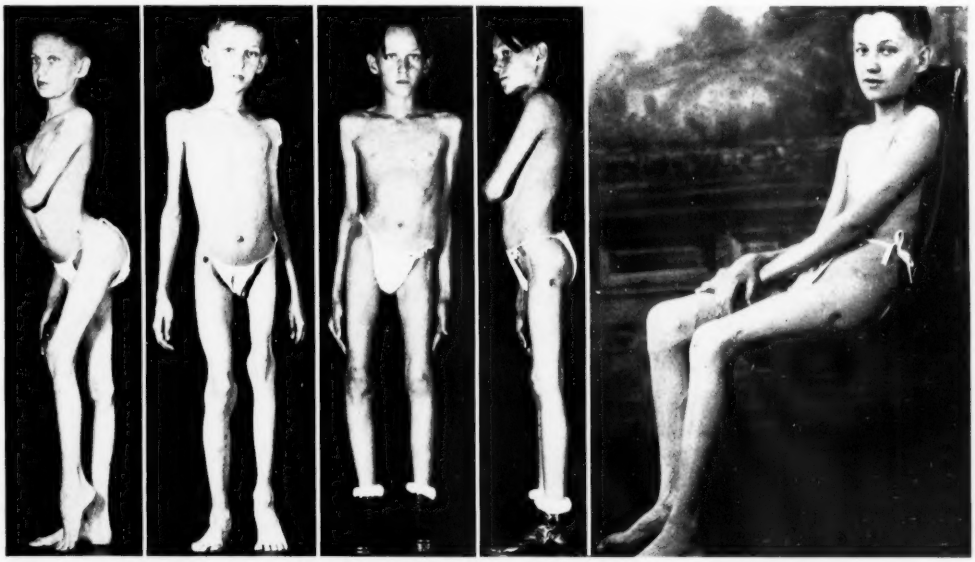


Fig. 2. V. W. D-146. Tuberculosis of the left hip with a severe flexion deformity.

Fig. 3. Front view of same patient as in Figure 2. The anterior superior spines are marked. Note the marked adduction of the left hip and shortening of the left leg.

Figs. 4 and 5. Front and side views of same patient as in Figures 2 and 3 after arthrodesis of left hip in a position of 22 degrees flexion and 17 degrees abduction. There is a ½ inch lift on the left shoe.

Fig. 6. The very satisfactory sitting position that a patient who has 22 degrees flexion of the hip is able to assume.

When Lovett published his table it was with the idea of providing a means by which the amount of abduction or adduction present could be accurately and easily determined. By a reverse process we have used his figures to determine the best functional position to place a lower extremity following operations for stabilization of the hip or operations for correcting a pre-existing deformity.

The first step is to determine the exact amount of real shortening, by measuring the two extremities from the anterior superior spines to the sole of the feet. When taking these measurements, it is essential that the two extremities be placed in the same position regarding flexion and adduction or abduction. Since an extremity will measure slightly longer when in a position of adduction than when abducted, it is evident that the real shortening cannot be found unless the two extremities are measured under like conditions. If, for example, it has been found that the real shortening is 2 inches and it is desired to place the extremity in such a position as to result in an apparent shortening of ½ inch, the difference of 1½ inches must be gained by abduction. By referring to Lovett's table (Table II) the angle is found to vary with the width of the pelvis. If the distance between the anterior superior spines measures 8½ inches, it is found that a position of 10 degrees abduction would be correct.

In cases in which the degree of abduction is to be from 10 to 18 degrees, an apparent shortening of ¾ inch should be allowed. Those patients (Fig. 4) in whom the maximum amount (18 degrees) of abduction is approached usually walk with a better gait if a lift which practically equals the amount of apparent shortening, is placed on the sole of the shoe. As stated above, the amount of lift can be gradually decreased as the pelvis increases in width.

Patients are frequently seen in whom the amount of shortening is so great that it cannot be corrected by an angle of abduction of less than 18 degrees. On such occasions we have deducted 2 inches in addition to the desired amount of apparent shortening and resorted to a lengthening operation after the hip has been firmly ankylosed in such a position as to compensate for the remaining shortening.

The question naturally arises as to what method of postoperative fixation was used. In cases that we have treated, as outlined above, the patients have been chiefly those in whom there has been

Fig. 7. X-ray of case shown in Figure 2. Tuberculosis of left hip in a position of adduction.

Fig. 8. X-ray of case shown in Figure 7 after arthrodesis of left hip and bending osteotomy of the femur. Plate shows the extremity in a position of 17 degrees' abduction which corresponds with the physical finding.

solid bony ankylosis of the hip following arthritis or those who have had tuberculosis of the hip which was treated first by obtaining a solid ankylosis in wide abduction according to the method described by Abbott and Fischer in their article entitled "Arthrodesis of the Hip" to be published and then later correcting this deformity by an osteotomy through the upper end of the femur and the gradual bending of the callus about 14 days after operation. The final position, as determined before operation, was obtained with the aid of a goniometer and held with a well fitting double spica until union was complete. The results have been very gratifying and the final position obtained has varied only 2 or 3 degrees from the position as determined before operation.

Sufficient time has not elapsed to draw any conclusions from those cases of tuberculosis that were treated by extra-articular arthrodesis and placed in the correct position at the time of operation. Since there is a tendency for these cases to shift into adduction and flexion, it may be desirable slightly to overcorrect them at the time of operation. In any event, it is desirable that the operator have in mind, before operation, the position which would offer the best functional result.

The following single report is sufficient to serve as an example. All X-ray pictures and photographs accompanying this article were taken from this case, which was selected because a position of 17 degrees abduction was obtained; 18 degrees being considered as the maximum that is compatible with a satisfactory gait.

V. W. D-146, boy, aged 12 years. Patient was admitted to the Shriners' Hospital for Crippled Children, September 6, 1927, because of a marked flexion and adduction deformity of the left hip associated with shortening of the left lower extremity. The onset of his illness was at 4½ years of age, when a limp was noticed. About a year later he began to have an elevation of temperature and complained of pain referred to the left hip. In a short time he was unable to walk. A large abscess developed and was drained. A discharging sinus remained for several months. Treatment has consisted of the application of a plaster cast, which was worn about 6 months, followed by a brace.

Examination disclosed an undernourished boy who walked on the toes of the left foot and who had a marked lordosis of the lumbar spine (Fig. 2). There was apparent shortening of the left leg of about 4 inches (Figs. 2 and 3). The left hip was flexed and adducted and there was passive motion of a few degrees. X-rays (Fig. 7) showed that there had been a destructive process involving the left hip and that there was almost a complete absence of the head and neck of the femur. The left hip was in a position of adduction.

Clinical and X-ray diagnosis: tuberculosis of the left hip.

First operation. September 12, 1927, a Steinmann pin was drilled through the lower end of the left femur and the flexors of the hip that have their origin from the anterior superior spine were divided subcutaneously. Heavy traction was applied to the Steinmann pin for a period of 3 weeks. Starting in the line of deformity, the position of the hip was gradually changed until a position of 5 degrees abduction and 35 degrees flexion was obtained.

Second operation. November 28, 1927, the left hip was exposed through the usual Smith-Peterson incision. A small spicule of bone representing the neck of the femur was removed, the acetabulum was cleaned out and the upper end of the femur roughened. By placing the extremity in wide abduction and slight hyperextension the upper end of the femur could be placed in the acetabulum, thereby

TABLE II.—FOR ESTIMATING THE DEGREE OF LATERAL DISTORTION

Difference in inches between real and apparent shortening	Distance between Anterior-Superior Spines in Inches																	
	3	3¼	4	4¼	5	5¼	6	6¼	7	7¼	8	8¼	9	9¼	10	11	12	13
¼	5°	4°	4°	3°	3°	2°	2°	2°	2°	2°	2°	2°	2°	1°	1°	1°	1°	1°
½	10	8	7	6	5	5	4	4	4	4	4	4	4	3	3	3	3	2
¾	14	12	11	10	8	8	7	7	6	6	5	5	5	4	4	4	3	3
1	19	17	14	13	11	10	9	9	8	7	7	7	6	6	6	5	5	4
1¼	25	21	18	16	14	13	12	11	10	9	9	8	8	7	7	7	6	6
1½	30	25	22	19	17	15	14	13	12	12	11	10	10	9	9	8	7	7
1¾	36	30	26	23	20	18	17	15	14	13	13	12	11	10	10	9	8	8
2	42	35	30	26	23	21	19	18	16	15	14	14	13	12	12	10	10	9
2¼		40	34	30	26	24	21	20	19	17	16	15	14	14	13	12	11	10
2½			39	34	29	27	24	22	21	19	18	17	16	15	14	13	12	11
2¾				38	32	29	27	25	23	21	20	19	18	17	16	14	13	12
3				42	35	32	29	27	25	23	22	21	19	18	18	16	14	13
3¼					39	36	32	30	27	26	25	22	21	20	19	17	15	14
3½						40	35	33	30	28	26	24	23	22	21	19	17	16
3¾							38	35	32	30	28	26	25	23	22	20	18	17
4							42	38	35	32	30	28	26	25	23	21	19	18

bringing fresh bone surfaces in direct contact and under slight pressure. The wound was closed and a double plaster spica was applied to hold the left leg in the position just described. Plaster fixation was maintained until the next operation.

Third operation. April 2, 1928, through a short incision over the lateral side of the upper end of the left femur, the femur was exposed and divided subperiosteally by a transverse osteotomy, at a point about 2 inches from the ilium. After the wound was closed, patient was placed in the bivalved plaster spica that had been worn before operation.

On the eighteenth postoperative day, this plaster was removed and both lower extremities were placed in traction. The position of the left leg was gradually changed in order to correct the extreme degree of abduction.

During this process of bending, the right hip was placed in the same position as the left and the following measurements were recorded: width of pelvis between anterior superior spines, 8½ inches; anterior superior spine to sole of foot, left 31½ inches, right 34½ inches. As there was a real shortening of 3 inches, it was decided to compensate for 2¼ inches by abducting the hip so that there would be a remaining apparent shortening of ¾ inch. By referring to Lovett's table it was found that the degree of abduction desired would be 15 degrees. When this amount of abduction and 25 degrees flexion with slight external rotation was obtained, fixation was maintained by a double spica until union was complete.

February 6, 1929. This patient returned to the clinic walking with only a slight limp and was able to assume a good sitting position (Figs. 4, 5, 6, and 8). There was no pain or discomfort in the back. The measurements were as follows: width of pelvis 8½ inches; anterior superior spine to sole of foot, right, 36½, left 33½ inches; umbilicus to sole of foot, right 38, left 37½ inches. When the lumbar spine was flat a point on the leg 24 inches from the trochanter was 9 inches from the table. These measurements show a real shortening of 3 inches and an apparent shortening of ½ inch. According to the Lovett and Kingsley tables, the hip was in a position of 17 degrees abduction and 22 degrees flexion, which was practically the position that had previously been determined as ideal for this case. The functional result was excellent.

REFERENCES

1. Abbott, L. C. The operative lengthening of the tibia and fibula. J. Bone and Joint Surg., 1927, ix, 128.
2. Abbott, L. C., and Crego, C. H. Operative lengthening of femur. J. South. M. Ass., 1928, xxi, 823.
3. Kingsley, G. L. A method of determining the angle of flexion of the diseased leg in hip disease. Boston M. & S. J., 1888, cxix, 6.
4. Lovett, R. W. A method of estimating adduction and abduction of the leg in hip disease. Boston M. & S. J., 1888, cxviii, 240–243.

EDITORIALS

SURGERY, GYNECOLOGY AND OBSTETRICS

FRANKLIN H. MARTIN, M.D. ..... Managing Editor
ALLEN B. KANAVEL, M.D. ..... Associate Editor
LOYAL DAVIS, M.D. ..... Assistant Editor

WILLIAM J. MAYO, M.D. ..... Chief of Editorial Staff

FEBRUARY, 1931

FASHIONS IN SURGERY

[The Journal has been permitted to use in these columns the following paragraphs with which Dr. Cushing prefaced his Arthur Dean Bevin Lecture published elsewhere in this number. Eds.]

At the meeting of the Association of Pathologists and Bacteriologists held in Cleveland in the Christmas recess of 1901, Dr. G. W. Crile and I fell into an ardent discussion one evening over the recording of blood-pressure observations by means of a home-made apparatus which I had shortly before seen put to use in Riva Rocci's clinic at the Ospidale de S. Matteo in Pavia. We happened to be in ear-shot of Professor W. T. Councilman who exclaimed: "Is this what you young men call surgery nowadays?" And on our admission that it had seemingly little to do with pathological anatomy at least, he went on to say that he had just been made President of the newly reorganized Boston Medical Society, and would we come and ventilate ourselves on the matter at some scheduled meeting?

To this we consented and a year later, on January 19, 1903, to be precise, Dr. Crile dealt with changes in blood pressure during experimental procedures while I ventured to advocate the routine plotting of the pressures during the course of operations in the clinic. It went off better than we could have expected and as an outcome of the meeting a local committee of surgeons was appointed to look into our proposals and submit them to trial. Their comprehensive Report[1] published after a year's interval ended somewhat dubiously with this sentence: "The adoption of blood-pressure observations in surgical operations does not at present appear to be necessary as a routine measure."

Aware that the introduction of instruments of precision into the clinic had always met with temporary opposition, this mild rebuff was not entirely unexpected, and I find written at the end of the Report, a copy of which I still preserve, these lines from O. W. Holmes' "Song of the Stethoscope":

"Now such as hate newfangled toys
Began to look extremely glum;
They said that *rattles* were made for boys,
And vowed that his *buzzing* was all a hum."

This story has been told for the reason that it sets an approximate date when surgeons not only in this country but in other parts of the world had begun to show an awakening of interest in pathological physiology. From being primarily descriptive anatomists, surgeons with investigative tendencies during the generation, let us say, of Sir James Paget, had been drawn away from the dissecting room under the attraction of what was called surgical pathology. This activity in the next generation, under the stimulus of Lister, was superseded by the overwhelming interest in

[1] Bulletin No. 2, Division of Surgery of the Medical School of Harvard University, Report of Research Work, 1903-1904, pp. 1-41.

the bacteriology of wound infections, the proper study of which necessitated some knowledge of the experimental method. Safeguarded by the newly perfected operative technique, surgeons toward the end of the century found themselves, under the tacit leadership of Billroth, suddenly transformed into "internists," and the disorders of the alimentary canal became the particular object of attention. Though isolated individuals like Hunter had done so long before, surgeons as a class for the first time had begun to think in terms of function rather than of morphology, a striking contemporary example of this being furnished by the contributions to our knowledge of the disorders of the thyroid gland by Kocher and Horsley and Halsted.

Thus, broadly speaking, each generation has its investigative fashions which run more or less in the grooves of least resistance or greater promise. And just now it seems not improbable that the next twenty years will see a further concentration on the nutritional and endocrinological maladies which will necessitate a greater attention to biophysics and chemistry.

There have been of course discernible influences other than new knowledge that have had something to do with these changes of fashion. One thing that undoubtedly played a part in the withdrawal both by physicians and surgeons from active participation in pathology was the fact that at the opening of the present century this subject had become in our several schools and hospitals a highly specialized one covered by full-time and thoroughly trained appointees. In consequence, the clinician was no longer obliged and seldom encouraged to make his own autopsies, or even to study his surgical specimens upon which, indeed, the introduction of new and unfamiliar methods served to render him no longer capable of passing independent judgment. Because of this, though our opportunities to contribute to morbid anatomy are unparalleled, most surgeons have acquired a lamentable inferiority complex when brought face to face with a pathological problem.

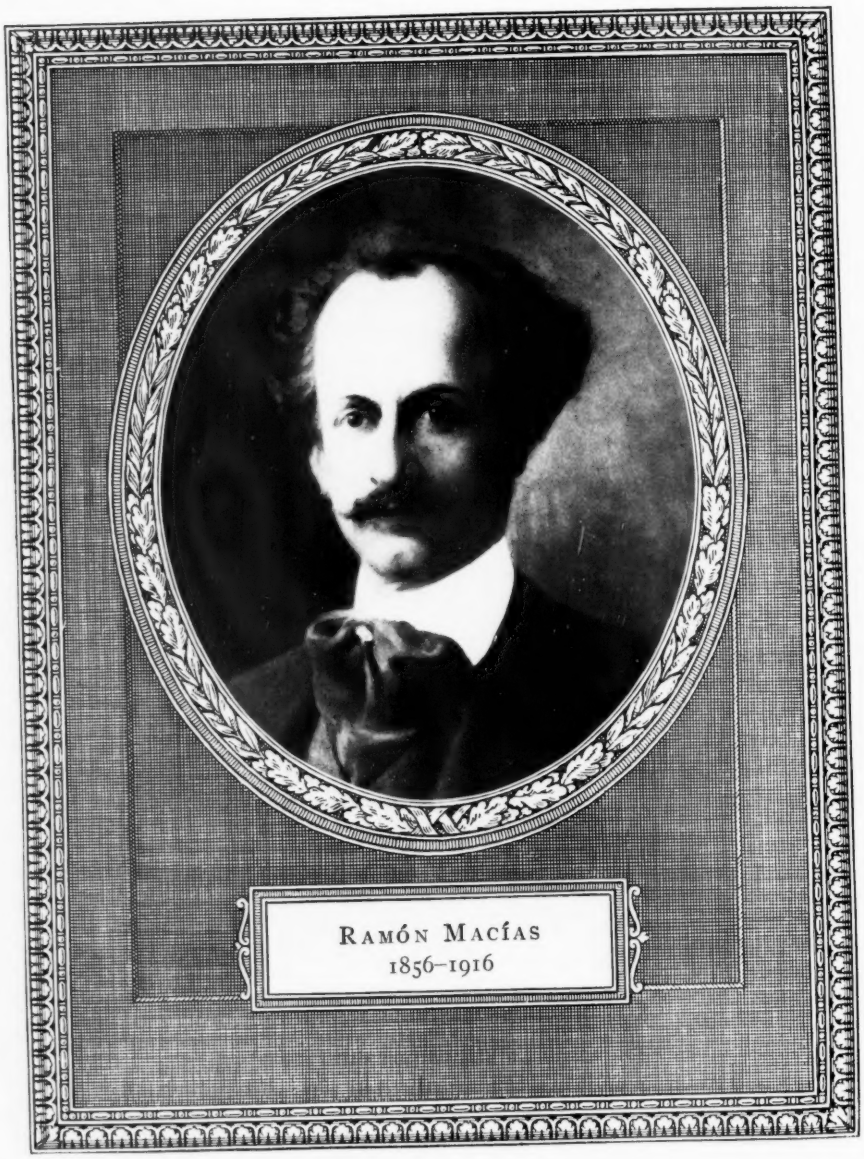
With this preamble and its reference to the regrettable lapse, first of the surgeon's active interest in normal anatomy, and then in its turn of his waning flair for morbid anatomy and bacteriology, I wish to emphasize the opportunities for the advancement of knowledge that still lie before him in these fields, if he will put his mind to it and give the necessary time. The professional pathologist has far more to occupy his attention than he can possibly cover and is only too glad to share with his colleagues of the bedside and operating table the material that principally interests them. I speak feelingly in this matter because the basis of my address is nothing more than an old-time surgico-pathological study.

It is a study, moreover, which could not have been made had it not been for the generosity of my pathological confrères in years gone by at the Johns Hopkins Hospital and more recently at the Brigham Hospital in permitting me to control the postmortem examinations on my own patients and in allowing me to retain the tissues. Not only has this been highly profitable from the standpoint of correcting diagnostic and technical errors, but as the specimens accumulated, the collection has made possible the subsequent group-study of problems which otherwise could scarcely have been attacked. The life history of a given pathological lesion can be determined only by long experience; it does not hang solely on the impression gained by a look through the microscope. Only when taken in conjunction with the character of the operation performed and with the survival period in a long series of cases does prognosis become determined.

Slowly and laboriously the surgical treatment of brain tumors has begun to emerge from the discouragements and uncertainties of earlier days. The more dreaded of the immediate complications following intervention that so harrowed our predecessors have been largely eliminated by improvements in operative technique; more exact methods of localization have made exploratory operations far less haphazard than they once were; regions formerly regarded as hopelessly inaccessible are now unhesitatingly laid bare; tumors of sorts that a few years ago were thought to be inoperable are now attacked with a reasonable degree of confidence. What is more, the general practitioner is on the alert for these lesions so that they come under observation in stages increasingly favorable for treatment; and what is no less important, patients no longer regard an intracranial operation as one to be particularly dreaded.

All this is in marked contrast to the days some of us vividly remember when these operations were rarely undertaken except as a last resort; when cerebrospinal fistulæ and fungating wounds were common sequels of intervention; when such simple procedures as tapping of the ventricles were looked upon as hazardous; when tuberculoma and gumna were supposed to be the more common types of tumor; and when the majority of patients were in the stage of approaching blindness, for the ophthalmoscope was not yet part of the practitioner's armamentarium.

When one contrasts those well remembered days with the present, the labor surely has not been in vain. Could one of the pioneers of intracranial surgery of the past generation see a meningioma dislodged from beneath the optic chiasm in a conscious and co-operative patient with immediately demonstrable improvement in vision, or in another, a tumor electrically dissected out from the cavity of the third ventricle, he would certainly look on in amazement. And no less certainly would the neurological surgeon of today have reason for amazement could he foresee the novel procedures which those of the next generation will unquestionably come to develop, for we are only at the beginning.



RAMÓN MACÍAS
1856–1916

UNIV. OF MICH.

MASTER SURGEONS OF AMERICA

RAMON MACÍAS

A GREAT genius in the surgical world was Ramon Macías who was born on February 14, 1856, in the small and picturesque town of Villa de los Reyes de Salgado, Michoacan. In the same town and in the same house one of the most illustrious members of the Mexican clergy was born—Dr. Don Clemente Munguia, Archbishop of Michoacan.

Ramon Macías was the son of poor parents, Señor don Cayetano Macías and Señora doña Teodora Zepeda, who were obliged to change their residence frequently to secure the necessities of life. The boy Ramon obtained his primary education in the schools of Los Reyes and Lerma. He took a course in Latin in the Ecclesiastical school of Pátzcuaro and then entered the historical college of San Nicolas de Hidalgo in Morelia to begin his preparatory and professional studies.

When he was very young he resolved to devote his life to the study of medicine because he felt that that was his true vocation. He had to overcome great difficulties in order to continue his studies in the National School of Medicine. He entered the Military Hospital as a candidate and on the completion of his course was given the rank of Major as a military physician and surgeon. He served in the army of the Occident under General Manuel Gonzalez and was then commissioned to study yellow fever in the states of Tabasco and Yucatan. At this time he was a follower of the great surgeon, Dr. Francisco Montes de Oca, whose memory is still honored as a surgeon and as organizer of the Medical Military Corps.

As a result of his brilliant work in a competitive examination Macías was made an assistant professor of clinical surgery under Dr. Rafael Lavista, a position which he held until the death of his chief, whom he succeeded, then becoming professor of surgery. Dr. Macías was especially fitted for this position because of his surgical skill and his extraordinary gift of imparting to his students his knowledge of the difficult art of surgery and of teaching them how to interpret the clinical signs and symptoms of patients.

He showed remarkable genius in making diagnoses even in the most difficult cases: for instance, before catheterization of the ureters was known and before the X-ray was of use in such cases, he diagnosed a ureteral calculus impacted at the

mouth of the ureter to the astonishment of the physicians of his time. His diagnosis was confirmed when the patient was operated on in Europe.

He invented various instruments for operations on the bladder and he was among the first to use tincture of iodine as a skin and internal disinfectant in some diseases of the circulatory and respiratory systems.

His method of performing prostatectomy deserves special mention. His technique was taught to Professor Albarran, of Paris, by one of Macías' pupils, Dr. Reynaldo Deffis. The name of Dr. Regino Gonzalez also should be credited with Dr. Macías in the working out of the technique for the prostate. Together they operated on an old prostatic with complete obstruction. They operated through a perineal incision and canalizated the bladder. During the operation it occurred to them that it might be possible to enucleate the prostate, the cause of the obstruction. This they did and the patient was cured, and lived some years free of his disease. They repeated the operation on various other patients and improved their original technique. At this time Dr. Deffis had planned a trip abroad so they took advantage of this opportunity, and had Dr. Deffis explain the operation to some of the surgeons of Europe. The operation was received with enthusiasm by Albarran and Guyon and thence became used generally throughout the world. This operation alone should preserve the name of the illustrious surgeon, if there were no other reason for it.

Dr. Macías was a man of the world with a vast general knowledge, acquired on his many voyages to Europe, where he filled the diplomatic post of assistant at the Mexican Legation in Paris, and in the United States. He had an affable disposition, was an interesting conversationalist, was always ready to do good, and was one of the most outstanding figures in scientific and social circles. He also was alderman of the Capital and president of the Council of Health.

As director of the Morelos Hospital for many years he introduced many scientific improvements and materials into this old hospital, one of the wards of which still bears his name as a homage to his memory. While operating on a patient in this hospital he acquired an infection of the index finger of the left hand which in the course of time brought about an aneurism of the aorta. When he was driving home in his carriage one day the aneurism ruptured, causing immediate death. The doctor failed to leave the carriage when his home was reached and the driver discovered that the doctor was dead. This occurred on September 19, 1916.

Death thus closed prematurely the life of this master, this man of science, this great-hearted man who knew neither hate nor rancor. He was mourned by his students, his patients, and his many friends. This life of labor which had yielded so many and such excellent fruits was ended without pain or bitterness, when perhaps the mind was busy pondering over some new operation, some new method of relieving pain. Men like Dr. Macías are an honor to their name, to their country, and to humanity.

ULISES VALDES.

THE SURGEON'S LIBRARY

OLD MASTERPIECES IN SURGERY

ALFRED BROWN, M.D., F.A.C.S., OMAHA

THE EBERS PAPYRUS

WHEN, in the middle of the last century, explorations in Egypt began to be carried out carefully, two famous documents, the *Papyrus Smith* and the *Papyrus Ebers*, came to light at approximately the same time. When or where the latter was found is not definitely known. It was as early as 1864 in the possession of Mr. Edwin Smith and was purchased by Mr. George Moritz Ebers in 1872 when he was in Luxor. The document consists of a roll a little over sixty-six feet in length and twelve inches wide. It is made of sheets of papyrus joined together and the pages thus formed are covered with hieratic writing varying from twenty to twenty-three lines to the page or division. This writing is of a later date than the copy of the *Papyrus Smith*, and Ebers judged that the manuscript dated back to the period between 1553 and 1550 B.C. That the manuscript is a copy or rather a collection of a series of smaller old works is admitted by practically all experts in Egyptology so the exact date of its integral parts is not known.

Shortly after obtaining the papyrus Mr. Ebers set to work to unroll it and get it ready for preservation and publication. He was able to do this work so rapidly that the copy of the papyrus was soon ready to be made and in 1875 the two volumes containing the reproductions of the manuscript were published. The reproductions are preceded in the first volume by an introduction by Ebers and in the second by a Latin glossary of the hieratic terms which had been transposed into hieroglyphics by Ludwig Stern. In the introduction Ebers gives examples of the various types of hieratic characters according to their dates and in this way establishes the approximate date of the papyrus. He also gives a complete summary of the contents of the work. No attempt at a full translation was made at this time and this publication appeared under the title "Papyros Ebers, Das hermetische Buch ueber die Artzneimittel der alten Aegypter in hieratische Schrift. Herausgegeben, mit Inhalts Angabe und Einleitung versehen von Georg Ebers. Mit hieroglyphisch lateinischem Glossar von Ludwig Stern. 2 Bde. Leipzig, 1875." It was not until 1890 that the work was translated completely and it then appeared, translated into German by H. Joachim under the title "Papyros Ebers. Das alteste Buch ueber Heilkunde. Aus dem Aegyptischen zum ersten male vollstandig uebersetzt. Berlin, 1890." The title is of course faulty as it is not the "Oldest Book concerning Healing" but the contents of the Smith papyrus were known only in part in 1890 and the work had never been translated completely, so Joachim's title for his book was justified.

The Papyrus Ebers appears to be just the reverse of the Papyrus Smith. In the latter there is only one case in which recourse to magic and the mystic is taken as a method of curing disease. All the other cases are studied carefully and scientifically with all reference to the supernatural left out, which would make it appear that the one case slipped in inadvertently or was added by a later author. This refers, of course, only to the body of the work and not to the material on the back of the roll. The major part of the *Papyrus Ebers*, however, appears to be a typical recipe book of the magical age of medical practice and in all approximately 973 recipes are given for use in various diseases. These constitute practically all the ways in which drugs and medicaments can be used; plasters, poultices, cataplasms, clysters, pills, drinks, boli, suppositories, and so on. Much is said of the methods of accompanying incantations, etc., with which these are to be used.

Putting all this aside there are parts of the *Papyrus Ebers* that represent a type of surgery which was being used at the time in Egypt which had nothing to do with the occult. The description as given reminds one of the style of the Smith papyrus and the fact that the papyrus refers to an unknown medical work as the "Secret Book of the Physician" it may possibly be that such was the title of the work of which the Smith Papyrus is a partial copy. For example "If thou findest a pus tumor in any part of a person and seeest that the centre of this rises, and it is hemmed in having a rounded form, then sayest thou 'it is a pus tumor, which is present in his flesh. This will I treat with the knife,' etc." This form of placing the subject before the reader occurs many times in the truly surgical portion of the *Papyrus Ebers*. Taken in conjunction with the similarity of method of treatment of wounds advised in the two documents and the admitted fact that the *Papyrus Ebers* is a collection copied from many authors it is probable that adding the surgical matter of the Ebers document to that of the *Smith Papyrus* will give a fairly good summary of the surgical knowledge possessed by the better type of ancient Egyptian practitioner.

REVIEWS OF NEW BOOKS

THE striking feature about *Radium and Cancer*[1] by Fitzwilliams is that the author brings forth the subject of radium therapy from the standpoint of a surgeon. This is indicated in many places; for example, it is unnecessary to protect the clavicle in surface irradiation of breast cancer; needles are inserted into rectal cancer through the rectal mucosa; gastrostomy is recommended in cases of carcinoma of the œsophagus; and, the fenestration operation is recommended in certain cases of carcinoma of the larynx, together with a low tracheotomy.

The fundamental principle of using small content platinum needles, eliminating all beta rays, over a 5 to 10 day period of exposure is brought into play in every possible instance.

Through the text are found case reports bearing upon the subject as it is dealt with in general terms. These reports add greatly to the effectiveness of the author's efforts. The illustration of applicators, of application, and the color representations of lesions showing the results of treatment are well made and of great value. One might especially call attention to the chapters on breast carcinoma, rectal carcinoma, and uterine lesions.

The note extending all through the book is that of lack of adequate amounts of radium and proper form with sufficient elasticity for the best possible known technique. In general, one obtains the impression that the use of radium in malignancy by experienced surgeons is assuming real proportions as an aid to other surgical measures and that radium therapy is in a process of evolution which may change from month to month. In short, the author wishes to present his impressions gained thus far, simply as a stepping stone to further development of curietherapy as it is referred to. The list of references is rather meager and almost exclusively European.

This book should be carefully studied by every surgeon dealing with malignancy involving the structures which are discussed. A. JAMES LARKIN.

THE new edition of *A Text-Book for Midwives*[2] by Fairbairn appears 6 years after the last. It has undergone a general revision and some rearrangement of its matter without adding many pages, however.

The book is well written. It contains all of the essentials a midwife should know, and what is better still, its directions for the management of complications are safe. Any midwife who follows these instructions will not tamper with a patient so as to make it more difficult for the physician to render adequate service.

The reviewer found little to differ with the author. It is to be regretted that he did not stress watching more closely the baby's heart in normal labor.

Under breech delivery great stress is laid on the necessity for prompt delivery of the head and also on the higher fetal mortality rate yet it states that a midwife may deliver these patients without medical assistance. The Central Midwives' Board now permits the midwife to attend "uncomplicated cases in primiparæ and multiparæ alike, and it may be fairly stated that the delivery of the aftercoming head requires as much judgment and skill as anything the midwife has to do."

In spite of this criticism this is a good book.

E. L. CORNELL.

THE small book[3] by Sir Robert Jones was originally written in 1915 as a war manual and has gone through three editions and many reprintings. It is a very readable and useful treatise on the more common injuries to the various joints and the adjacent bones, and contains much information as to the diagnosis and prognosis, together with many valuable, practical, and simple methods of treatment. The vast experience and unerring surgical judgment of the distinguished author are everywhere in evidence. E. W. RYERSON.

TWO volumes constitute the latest additions to the series entitled *Clinical Radiology of the Digestive Tube*,"[4] and are published under the direction of Pierre Duval, J. Ch. Roux, and Henri Béclère. The first volume of the series appeared 2 years ago and is already out of print. The methods of presentation followed in the first volume are continued in the present volumes. The cases have been very carefully chosen to illustrate certain points in clinical radiology. The text constitutes a running commentary of the facts which the authors consider justification of the diagnosis. Roentgenograms accompanied by explanatory outline drawings add to the value of the book. None but operative cases have been published. This valuable roentgenological atlas should be helpful to every roentgenologist and to the physician especially interested in gastrointestinal disorders. JAMES T. CASE.

[1] RADIUM AND CANCER (CURIETHERAPY). By Duncan C. L. Fitzwilliams, C.M.G., M.D., Ch.M., F.R.C.S. London: H. K. Lewis & Co. Ltd.; New York: William Wood & Company, 1930.

[2] A TEXT-BOOK FOR MIDWIVES. By John S. Fairbairn, M.A., B.M., B.Ch. (Oxon.), F.R.C.P. (Lond.), F.R.C.S. (Eng.). 5th ed. London and New York: Humphrey Milford Oxford University Press, 1930.

[3] INJURIES TO JOINTS. By Sir Robert Jones, Bart., K.B.E., C.B., Ch.M., F.R.C.S., F.A.C.S. 3d ed. New York and London: Oxford University Press, 1930.

[4] RADIOLOGIE CLINIQUE DU TUBE DIGESTIF. Published under the direction of Pierre Duval, J.-Ch. Roux, Henri Béclère. Oesophage, Intestin, Foie et Glandes annexes. By J. Gatellier, F. Moutier, P. Porcher. Parts I and II. Paris: Masson et Cie, 1930.

A. Grey Turner

SURGERY, GYNECOLOGY AND OBSTETRICS

AN INTERNATIONAL MAGAZINE, PUBLISHED MONTHLY

VOLUME LII FEBRUARY, 1931 NUMBER 2A

IDEALS AND THE ART OF SURGERY[1]

PROFESSOR G. GREY TURNER, NEWCASTLE-UPON-TYNE, ENGLAND

"It is the purpose of every man's life to do something worthy of the recognition and appreciation of his fellow men. . . . By their superior intellectual qualities, their fidelity to purpose, and above all their indefatigable labor the few become leaders." *J. B. Murphy.*[2]

LEST WE FORGET

JOHN BENJAMIN MURPHY, whose memory we are met to honor, has now been dead for 14 years, and there are doubtless many here this evening who never saw him (Fig. 1), and who never heard his voice, and to whom his magnetic personality is only a tradition. Even one of your orators had to confess that he only knew Murphy through his works, and that must be increasingly so with the orators of tomorrow. In this I count myself fortunate for I had the great privilege of knowing Murphy and, as our Lord Grey said of your Colonel Roosevelt, "I saw enough of him to know that to be with him was to be stimulated in the best sense of the word for the work of life."

It is well that each succeeding generation should be familiar with the main facts of Murphy's life and work. For all time he will be known as a great surgeon and as an outstanding teacher, but what manner of man was he, and how did he attain to the unique position he held?

John Benjamin Murphy came of hardy stock, his parents being immigrants from the Emerald Isle, who had the outlook and courage to seek opportunities away from the land for which at that time "God had done so much and man so little" (T. P. O'Connor). Of these parents he was born on a farm in Appleton, Wisconsin, on December 21, 1857, and his early country life and struggles were no doubt a splendid preparation for the future. As a boy he was industrious, and it is recorded that for a time he acted as a pupil teacher to further the ends he had in view. It was in those years that he learned the habit of systematic work, a habit that was to become a ruling passion. Even then he must have felt the truth of what he said 45 years later in his presidential address before the American Medical Association—"Competency is attained and maintained only by zeal, indefatigable labor and continued efforts in self education."

After graduation from Rush Medical College, in 1879 he won first place as interne, one of the most valuable positions a young man can hold in Cook County Hospital. Fresh from this hospital experience, he joined Dr. Edward Lee in general practice which, as many of us have found, is by far the best introduction to the study of afflicted humanity—the sick person and the way he reacts to his environment, for illness, like alcohol, brings the best or the worst out of a man. There is no period in the life of a surgeon when this knowledge can be so well acquired as in his

[1] The John B. Murphy Oration in Surgery, delivered at Clinical Congress of American College of Surgeons, at Philadelphia, October 13–17, 1930.

[2] Presidential address to American Medical Association, June, 1911.

early days. Murphy was always a great doctor, and both his work and his writings showed the effect that this period of his life had stamped on his individuality. No one realized better the opportunities and responsibilities of the family physician, as he showed by that masterly presidential address from which I have just quoted.

After some 2 years in practice he took an 18 months' tour in Europe, and studied especially in Vienna. In that renowned center of medical learning he came under the spell of Billroth, that master mind in surgery, whose pupils for many years filled all the important surgical chairs in the Teutonic universities, whose portrait or bust is found in every hospital in his native city, and whose centenary has recently been signalized by the issue of an Austrian two-shilling piece embossed with his fine head in profile. Another surgeon who greatly impressed Murphy was Albert, also a famous teacher, whose statue adorns the hall of honor of his own University of Vienna.

Like all good students of these great masters, he was fired with still greater enthusiasm for clinical surgery. When he returned to Chicago he had the great good fortune to come into close touch with a first class surgical pathologist, Christian Fenger, whose name is venerated in your country as Billroth's and Albert's are in theirs, and in whose memory a medallion reposes in the theater in Rush Medical College, where I first saw Murphy at work.

Once settled again in Chicago he threw himself into active work, with much operative surgery carried out in the homes of the people, house to house surgery, which is a great training, and to which personally I know that I owe much. He cannot long have felt the lament of Sir William Macewen who said that for years he was his only pupil(!) for in his twenties he was appointed professor of clinical surgery in the Chicago Post Graduate Medical School. At 35 he attained a similar position in the College of Physicians and Surgeons, and at 44 (Fig. 2) he was made head of the surgical department of Northwestern University in Chicago. In 1905, he was appointed professor of surgery in his old school, Rush Medical College, but though he thus reached the height of his ambition, by that time his hands were already too full, and his wise life's partner realized that he could not continue to carry the burden entailed, and he resigned in 1908.

Of hospital appointments he held many and at the outset of his career he became surgeon to the Cook County, so that he early got the chance which William Hunter said was the way to make a man truly great in his profession: he became attached to a large hospital where he might attend the sick and dissect the dead! This appointment was followed by his nomination to the staff of the Mercy Hospital in 1895, where his clinic was soon to attain world-wide fame. In addition he held many other important surgical posts. Murphy was a firm believer in the importance and educational value of the societies and he was not only a regular attendant, but contributed unsparingly to their meetings. He was also a great traveller, and was well known in my country and on the Continent, and there were few surgical congresses which he did not attend. I so well remember his presence at the British Medical Association in 1905. At that time he was greatly interested in anæsthesia, and on whatever subject he talked he always managed to make some reference to his nurse anæsthetist, and he always began by saying that she was a delicate little woman not 100 pounds in weight! Murphy was a great advocate of open ether by the drip method, but he insisted that it was only very seldom properly administered. This was his constant theme. His remarks on this subject in the Introduction to the General Surgery volume for 1900 are a good example of his attitude, of his outspokenness, and his incisive style. "One can scarcely comprehend the degree of inefficiency with which anæsthetics are administered in many clinics and in most of the private practice in Great Britain, on the Continent, and in some parts of this country, unless he has been an eye-witness. With few exceptions, in the European clinics, ether is given as incompletely and with as much danger as it was 20 years ago, and chloroform is continually claiming its annual wanton sacrifices, which are absolutely avoidable." There is no doubt he was rather quick to arrive at conclusions, but

Fig. 1. John B. Murphy shortly before his death.

Fig. 2. John B. Murphy at about 40 years of age.

if he was convinced that he had spoken too hastily, or made an error, he was very willing to retract or to apologize.

Of honors he had many, and I am proud to remind you that the Honorary Fellowship of our English Royal College of Surgeons was conferred upon him in July, 1913, at the time of the International Congress of Medicine held in London. He was devoted to his religion and must have been greatly heartened when, in 1916, he was made a Knight Commander of the Exclusive Order of St. Gregory the Great.

Murphy was a pioneer in abdominal surgery, and a great deal of his best work was done in his early thirties and he was only 35 when he brought his famous button before the profession in a memorable paper.

He advocated the immediate treatment of acute appendicitis by operation, and at an early age compelled recognition of his views by his strenuous advocacy in face of great opposition from his seniors. In the treatment of peritonitis the Murphy drip method has become classical.

Independently of other workers, whose names are better known in this connection, he suggested in 1898, the injection of nitrogen into the pleural cavity to produce artificial collapse of the lung, and he was one of the first deliberately and successfully to suture a severed artery, and to remove successfully an embolus from an artery. His work on ileus, on ununited fracture, on ankylosis of joints, and in a host of other surgical fields, would have placed him foremost in the front rank of great practical surgeons, if he had not carved for himself the way to still greater fame as one of the greatest surgical teachers of all time. He realized the worth of his vast experience, and he wanted to make it a great heritage for his fellows. What ambition could be more ennobling? He not only saw the need for postgraduate teaching but he made it available for all without let or hindrance and without fee or direct reward.

As a surgical writer he was not so prolific as some others, but nearly every one of his 66 papers was a real contribution to surgical literature. With him the tide of the mind seemed to be always in flood, and his pen was a ready tongue for that active brain. His papers were all characteristic and thorough, and usually commenced with a review of the subject, and a statement of the anatomy concerned. Writing on ileus in 1896 he begins: "Before entering into the details of the subject, let us take a view of the mechanisms of the intestinal tract from the pylorus to the sphincter ani."

His position for many years as editor of the General Surgical Volume of the *Practical Medicine Series* gave him an opportunity, which he doubtless greatly relished, of writing forcible, trenchant, and fearless criticisms of the practice of the time. Many of his introductions give a wonderful insight into his character and his outlook on the duties and responsibilities of the profession.

My own personal knowledge of Murphy really began when I first started the study of clinical surgery in 1895, for his name already loomed very large on the surgical horizon. He was held up to us students as an American surgeon who had the audacity to recommend immediate operation in acute appendicitis. At that time this was contrary to British practice, and was looked upon as likely to lead to a good deal of unnecessary operating, although it must be said to their credit that many of the younger school were already following his teaching. It was not long after he had introduced his button, and this method of intestinal anastomosis was practically the only one we heard of, and certainly the only one that we, as students, ever saw practiced.

I heard so much of Murphy and his doings that I longed for an opportunity to see the man himself, and it was a great delight to me to find him in the surgical section of the British Medical Association at Leicester in 1905, and again in Toronto in 1906. His tall, athletic looking figure, his characteristic high pitched voice, his alertness, and if I may say so, his attitude of pained intolerance to those who did not immediately agree with what appeared to him to be as clear as the light of day, were all very striking. From Toronto I followed him to his home town, and I shall never forget the impressions derived from my visit to his clinics both at Rush Medical College, and at Mercy Hospital. Nothing could have exceeded his kindness, for he not only went out of his way to show me everything that he could during my brief visit, but I enjoyed the hospitality of his home and had the privilege of being introduced into his charming family circle. Anyone who has had this privilege must cherish the memory of Mrs. Murphy, a vivacious, charming woman, whose life work was her husband and family. She took the keenest interest in all that he did, and helped him largely with his experiments. A former orator, Raffelle Bastianelli, has recorded an incident showing how she constantly endeavored to lighten the burden of his practice. His work was her work, and I do so well remember a day in the Mercy Hospital when I happened to look up to the back of the gallery, and there was Mrs. Murphy and her daughters who had just come to see what John, her John, was doing!

Murphy was a great American and intensely proud of his country and of his beloved Chicago. I shall never forget the pride he took, nor the pride that I felt, in that he spared the time to show me the principal features of that great city.

From the outset I was impressed by his teaching and shall always vividly remember the morning of his first clinic and how much I was delighted when he compared the pathological processes underlying the extensions of an abscess in connection with a carious tooth to the same processes affecting the appendix and its relation to the peritoneal cavity. I had always been brought up with the greatest regard for the application of pathological principles to surgery, and at once recognized that here was a man who was so impressed with those principles that he used the simple and telling illustration which I have quoted in spite of the fact that he was absolutely at the head of his profession. Subsequent years and personal visits to many of the great master surgeons, have shown me that they often appear elementary in their teaching, for the fundamental truths of surgical pathology are

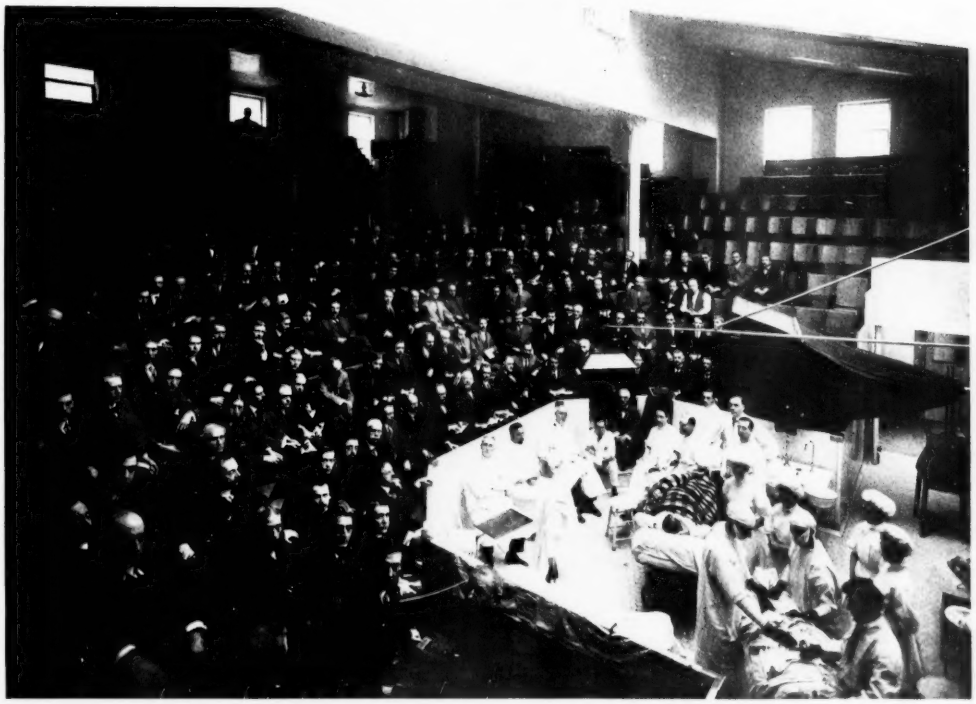


Fig. 3. Murphy in his clinic at Mercy Hospital, Chicago.

really simple though profound, but it requires a great man to be content to use them as illustrations. Reference to the Classics shows that the theme of these great writers was inspired by the every-day things of life, and has it not been said that only a great man can write an elementary textbook? Certainly Murphy delighted in driving surgical principles home, never talking above the heads of his audience or taking advantage of them by speaking only of obstruse problems. Those few days spent in Chicago were a tremendous inspiration to me, and I came away with an immense admiration for the man and his work. Four years later, in 1910, it was my extraordinary privilege to share with others the good fortune of having Murphy as a visitor in Newcastle. He came as a member of the Society of Clinical Surgery, and I shall never forget his spare figure with the slightest stoop and scarcely observable head tremor, standing at my side as I demonstrated cases and talked with what must have appeared to him as a too great assurance, for nearly two hours. I remember so well his interest, his rooted attention, and how he never interrupted to ask a question until the demonstration was over.

Murphy's own method of teaching was that which one usually associates with continental clinics, and I believe originated in Vienna, where Murphy probably first got the idea from his old masters, Billroth and Albert. The class assembled in an amphitheatre, and the patients were brought into the well; arena would not be an inappropriate word, for each case was made a clinical combat, every point being punctiliously thrashed out. Both at Rush Medical College and at the Mercy Hospital the accommodation for students and visitors was very large, probably seating for 200 being available (Fig. 3).

The clinical history was first read by an interne or student, Murphy the while on the alert, and freely criticizing and asking questions

to elucidate the points. He then demonstrated the various features of the case, illustrating them by diagrams or preparations. In his demonstrations he was greatly helped by the student or interne who, I often thought, must have been coached to be a sort of whipping boy but only to help on the sacred business of teaching. Murphy commenced his demonstrations early, and after talking incessantly for perhaps a couple of hours he began to operate, and either dealt with cases which had been demonstrated that morning, or previously, for certainly no case was treated that was not made the subject of a teaching demonstration. By this method, which Murphy pursued throughout the whole of his career, I estimate that he must have come into close contact with from 50,000 to 100,000 medical men. Just fancy what that must have meant —what an influence his direct personality must have wielded! Then there were the enormous numbers the world over who were reached by his writings, and especially by the *Murphy Clinics*, which were the printed record of his teaching days. It was as if his clinic were connected by wireless to those who had been visitors and who knew how to appreciate his teaching methods.

The visitor to a clinic of this sort who sees everything going on smoothly is apt to forget the enormous amount of preparation that must have preceded these demonstrations and in fact all Murphy's work. In this connection the words of your Longfellow seem very appropriate:

> "The heights by great men reached and kept
> Were not attained by sudden flight.
> But they, while their companions slept,
> Were toiling upward in the night."

When that preparation was carried out and how much of it Murphy personally supervised, I do not know, but well remember the great number of cases which he saw and dealt with during the morning spent with him at Rush Medical College, and I know how late it was before lunch time arrived!

But Murphy was not only a great and dynamic teacher, he was a pioneer, he could not help himself, his destiny was to blaze the trail, to chase opportunity with a naked sword. Like Father Jerome of the "Cloister and the Hearth," an internal flame consumed him, and his life was one of incessant toil. His life reminds one of our own John Hunter whose passion for work overcame the fear of death. Murphy's driving force was remarkable, and we are told that it wore out his associates, but, outwardly at least, it never seemed to tell upon himself. He had a lust for work and a great power of concentration. His life was an apt illustration of what Charles Kingsley said "I go at what I am about as if there was nothing else in the world for the time being."

Such incessant concentration as Murphy put into life must tell its tale, and when the warning message came in 1916 it was a bitter blow, and he tried to believe that it was a false alarm. Again like Hunter his answer to the challenge was to plan more work. But Nature will not be gainsaid and what was to be his fatal illness wore steadily on to his life's goal. Murphy knew perfectly well that

> "There is no armour against fate;
> Death lays his icy hand on kings."
> *Shirley.*

His fatal illness was very similar to that of Hunter, for they both suffered from an uncontrollable vertigo and from attacks of angina. Both men watched their own cases carefully, and both made a shrewd guess at what would be found after death. Dr. J. E. Keefe has recorded how Murphy, when he felt he was going to die, asked that a necropsy should be made, and dictated some notes on what he felt would be found.

The last days of Murphy remind me so much of the touching story of the death at Easter, 735 of the Venerable Bede, the Monk of Jarrow, that sanctuary of learning which is so near to my own home, that I venture to quote the story. Bede worked with his pupils about him. His last task was to complete his version of St. John's Gospel into the English tongue. On the day that he died dawn broke on another sleepless night, and again the old man called his scholars to him and bade them write. Amid tears and farewells the day wore on to eventide. "There is yet one sentence unwritten dear Master," said

the scribe. "Write it quickly" said the dying man. "It is finished now." "You speak truth," said the Master, "all is finished now," and with his head supported on his scholars' arms he passed quietly away.

Dr. C. L. Mix has recorded that when Murphy's illness became critical he said "If I am through I want to quit right away, I don't want to linger after my work is done." For himself he had no fear of death. He was familiar with it in all its aspects. If it was his turn he could go cheerfully without making ado, and he died as all brave physicians die.

The Great Hall of the American College of Surgeons was erected as a memorial to Murphy, and this annual oration was founded for remembrance of him, but as Longfellow said

". . . when a great man dies
For years beyond our ken,
The light he leaves behind him lies
Upon the paths of men."

The greatest honor that can be paid to the memory of Murphy is to endeavor to walk in his light.

There is another quotation from your great poet that was exemplified by Murphy's life, but it is so hackneyed that I fear to quote it, though so true that it must rise to the mind of each of us whenever we think of him.

Fellow Admirers, bear with me while I endeavor to show in some few ways how Murphy's work still lights the pilgrim surgeon's way.

ABDOMINAL EMERGENCIES

"The mortality in appendicitis is still too great. . . . It is far beyond that which timely and efficient surgical treatment affords. The present laxity in treatment appears to be due to the fact that the subject is not receiving the forceful attention in the literature that it did 10 or 15 years ago. This accentuates our belief that every topic in surgery should be rewritten by masters every 5 to 7 years to prevent decadence in practice."

J. B. Murphy, 1915.

"Let us return to our ideal, early operation is the only safe practice; we should not compromise with crime by procrastination."

J. B. Murphy, 1916.

IT was in connection with the early treatment of appendicitis by operation that the name of Murphy first came prominently before the profession. It was a doughty fight and ever and anon the champion had to take up the cudgels! Only the year before he died he wrote the words which I have placed at the head of this section, and now, 14 years after his demise, are we sure that the practice of the profession with regard to appendicitis is sound? Is all the blame for the considerable mortality due to the stupidity of an uninformed, untrusting, or recalcitrant public? In 1928 no less than 2,868 lives were lost from appendicitis in England and Wales alone, and in 1926 in the United States, 15,751 deaths were attributed to this cause.

"Get in quick and get out quicker" was a catch phrase attributed to Murphy, which has been constantly misunderstood, and which has been much criticized. The circumstances under which he first introduced it must be clearly realized. It was in those early days when he was fighting so strenuously to get the profession to see the importance of prompt operation in appendicitis that he urged that "procrastination was the thief of lives." Murphy was very bitter about the use of morphia in masking symptoms, and I remember the cynical look on his face as he told his audience that cases treated by morphia would recover in time to make excellent arrangements for their own funeral! Hence the necessity for early diagnosis followed by prompt interference, the "get in quick" of the slogan. It has constantly been urged that his doctrine so tersely expressed led to a great deal of unnecessary operating. That criticism is manifestly unfair. Murphy never suggested operating to make a diagnosis, and it

was indiscriminate diagnosis and not indiscriminate interference that led to the unenviable notoriety which the fashion for operating for so-called appendicitis brought about. The "get out quicker" has as frequently been misunderstood, and has been made an excuse for a good deal of slip-shod operating. At the time that the phrase was introduced most surgeons believed that it was necessary to endeavor to cleanse the peritoneum and this they attempted, either by irrigation or by mopping here, there, and everywhere, or even by wiping each individual coil of intestine, and picking off the protecting lymph. When fortuitously their patients recovered, the good result was attributed to this vigorous treatment—now we would say maltreatment —of the peritoneum, and about the time of my visit to Murphy's clinic I heard a prominent American surgeon say that he considered this cleansing of the peritoneum to be the most important part of the operation. Murphy's observations had taught him that this practice was entirely wrong, and that the focus, having been removed, it was only necessary to provide for drainage and to put the patient in the Fowler position, and it was to emphasize these principles of treatment that the second part of his phrase was introduced. But now many surgeons have gone too far and in omitting the safeguard of a drainage tube they rob their patients of a measure of protection which is their due. The provision of a drain track need never do harm, but to do without it may cause a fatality.

But all slogans are often misinterpreted, and all are apt to be dangerous. Further they frequently do not accurately represent what their authors originally meant. I well remember Doyen's "operate quickly" and the result of operating by the clock which followed. Nothing could be more dangerous, nothing could be more unwise, and not many things have done more harm to good surgery. What Doyen really said was "operate quickly and *well*" and I have no hesitation in urging that those surgeons who cannot operate well quickly had much better take more time, for it will certainly be time well spent so far as their patients are concerned. There can be no doubt about the truth of Murphy's teaching on appendicitis. To get in quickly means to make an early diagnosis and to remove the appendix before the inflammatory process has extended to any extent to the surrounding peritoneum. Personal experience must ever be the more valuable, and that is why I venture to quote the results of my own work. My small series shows the extreme value of the Murphy dictum. I have always classified my cases according to the extent of the pathological damage which has occurred up to the time of the operation, and I strongly deprecate those rules for treatment which are based on the number of hours which have elapsed since the onset of the attack. Pathological processes do not attend on the clock, and to expect them to do so is to court disaster.

Table I which follows shows my cases classified according to the extent of the pathological mischief.

It ought to be possible in these days to arrive at a diagnosis and to carry out treatment while the disease has not extended further than Group 3. When this is done the series shows that it is possible to present a group of 753 cases of acute appendicitis with 22 deaths, equal to a mortality of 2.92 per cent. But every surgeon knows that a good many cases reach the stage of localized suppuration before surgical interference is sought, and since these cases not infrequently occur without severe symptoms, it would be unkind

TABLE I.—ALL CASES OF APPENDICITIS TO END OF 1929. PROF. GREY TURNER

Group		Cases	Deaths	Per cent
1	Acute appendicitis without peritonitis	138	0	....
2	Acute appendicitis with localized peritonitis	402	4	0.99
3	Acute appendicitis with flank or pelvic peritonitis or both	213	18	8.45
4	Acute appendicitis with diffuse peritonitis	96	28	29.16
5	Appendicitis with residual abscess	64	5	7.8
6	Appendicitis with primary localized abscess	432	14	3.24
7	Appendicitis—interval removal	955	3	0.31
8	Appendicitis with primary complications	20	9	45.0
	Total	2320	81	3.49

to look upon them as the fruits of unwarrantable delay. If they are therefore added to the cases of the first three groups, we get a grand total of 1,185 cases of acute appendicitis in which the diagnosis was made and treatment carried out at what may be charitably looked upon as a reasonably proper stage, and with 36 deaths, a mortality of 3.03 per cent. These figures nearly approach the 2½ per cent which Murphy considered we might expect with the co-operation of the public and the profession. So far as they go they certainly support Murphy's slogan, and furnish every reason for adhering to it. But it is manifestly foolish to talk as if appendicitis should have no mortality. Such vaporing shows an entire lack of appreciation of the mutability of human affairs. Honest records must disclose some mortality, be the surgeon never so fortunate. In the 955 cases in which I operated for the removal of a quiescent appendix in an interval between attacks I had three deaths. One of these was from tuberculous meningitis, and I have been told that such a case might be excluded from the records. But when so tempted to water his returns, let the surgeon apply the acid test of looking at the results from the viewpoint of the relatives. The answer will leave him in no doubt as to how he should compile his figures!

Murphy frequently deplored what he called "epidemics of so-called conservatism" in dealing with appendicitis and in Britain we still suffer in this way. What I wrote in 1925[1] is unhappily true today. "I have watched the progress of the surgery of appendicitis in the district where I live, for over a quarter of a century, and during this time I have been witness to the results of the recurring advocacy of the delayed operation. Every time this plan has been written about in the medical press and generally discussed, it has almost at once been followed by an increased mortality."

The profession the world over ought now surely to realize that there is no medical treatment for appendicitis. It must also remember what Dieulofoy said as long ago as 1896: "It is not sufficient merely to operate, it is necessary to operate at the right time."

As my excuse for recurring to so threadbare a subject, I must plead that the facts show that appendicitis is still an extremely serious disease, for in England and Wales in the year 1928 it accounted for 0.6 per cent of the deaths from all causes, and in the United States for 1.2 per cent of the deaths from all causes in 1926.

If we now look at the surgery of ruptured ulcer, the same story is told. I have arranged my cases according to the number of hours that have elapsed since perforation and Table II shows the results.

In order to get a reasonably large series, I have added together those cases on which I have personally operated and those operated upon by Mr. Norman Hodgson, who has been associated with me as assistant and colleague for many years and whose methods and ideas on this subject are practically identical with my own (Table III).

TABLE II.—RUPTURED GASTRIC AND DUODENAL ULCER, PERSONAL STATISTICS TO END OF 1929. PROF. GREY TURNER

Hours after perforation in 6 hour periods	Total No.	Recoveries	Deaths	Percentage of deaths
Up to 6	40	39	1	2.5
7 to 12	67	60	7	10.44
13 to 18	21	17	4	19.04
19 to 24	15	10	5	33.33
Over 24	14	8	6	42.85
Grand Total	157	134	23	14.64

All cases operated upon within 12 hours. Total 107 with 8 deaths, or 7.47 per cent.

[1] Brit. M. J., 1925, May 2.

TABLE III.—RUPTURED GASTRIC AND DUODENAL ULCERS TO END OF 1929. PROF. GREY TURNER AND MR. NORMAN HODGSON

Hours after perforation in 6 hour periods	Total No.	Recoveries	Deaths	Percentage of deaths
Up to 6	119	115	4	3.36
7 to 12	148	129	19	12.83
13 to 18	40	33	7	17.5
19 to 24	21	15	6	28.57
Over 24	37	18	19	51.35
Grand Total	365	310	55	15.06

All cases operated upon within 12 hours. Total 267 with 23 deaths, or 8.61 per cent.

The figures are extraordinarily interesting and show that it is the time factor, the "get in quick" which has everything to do with the results in these great emergencies. The mortality may appear high, but the condition is admittedly much more serious in its early stages than appendicitis, and the diagnosis is sometimes puzzling. Though the symptoms are usually insistent they may be masked and this, together with transport difficulties, often accounts for the delay which elapses between the calamity of perforation and operation. Nevertheless, the figures once again amply illustrate the truth of the dictum of Murphy. In acute diseases nearly the whole secret of success is to operate early and to make the operation as simple as possible. The accident of perforation is always an extremely serious one, and for many years I have taken the view that our duty is to get the patient over the catastrophe as safely as possible, leaving the treatment of the ulcer for subsequent intervention should it prove necessary. "The obligation of the surgeon is to conduct his cases to a favorable termination *with the least hazard or risk to the patient*"—(J. B. Murphy, 1904). For years now I have merely closed the ulcer, mopped out the peritoneum in the vicinity and in some cases have left a tube in the pelvis. This is exactly what Murphy advocated (writing in collaboration with Dr. J. M. Neff) as long ago as 1902. Matters of technique and after-treatment may make some difference to the results, but are as nothing compared with the importance of prompt diagnosis and interference. In the district in which I live and work the profession is well aware of this, and it is a great tribute to them that of a total of 365 cases quoted in my table, no less than 73.15 per cent reached surgical aid within 12 hours. This happy state is due to the better education of the profession as the result of the abundant clinical opportunities which our students enjoy and the way that the contributing doctors take advantage of the post graduate training which is now so readily available. The readiness with which patients agree to come into hospitals since the education of the war, and the increased facilities for transport must both have some share of the credit. Other emergencies tell the same tale, and if time had permitted I should have liked to deal with the subject of strangulated hernia. Murphy deplored the high mortality in this condition and it is difficult to understand why it should still remain in the region of 20 per cent, while the death rate following the radical cure of all varieties of external hernia (not excluding the bad risks, like the large umbilical and ventral types) is considerably less than 1 per cent.

> *"The State is best governed as you cook little fish, without much busyness."*
>
> *Laotze.*

And so it should be with most of our operations. In emergencies the poor are really the better off for with them there is no incentive for delay. They are taken to hospital promptly, and are operated upon with little ado and most excellent results. On the other hand when the patient belongs to the titled classes or the upper ten, he is usually less fortunate. Often quite unnecessary consultations are called for, important relatives are to be seen or business affairs arranged, and so valuable time is frittered away. Then the operation and the convalescence are conducted in an atmosphere of apprehension and suspense which ill assorts with smooth recovery.

THE PLACE OF THE MURPHY BUTTON IN THE DEVELOPMENT OF GASTRO-INTESTINAL SURGERY

> *"We can escape a fall only by continually climbing."*
>
> *Pascal.*

It is due to the memory of Murphy to emphasize the great influence which his method of anastomosis has played in the development of modern gastro-intestinal surgery.

Up to his time the methods employed had been very unsuccessful and were for the most part cumbersome and difficult. His apparatus was highly ingenious, was very quick, and was a great advance on any method then existing. I am reminded of a story of one of our north country surgeons, a namesake of Dr. Murphy, who when the button first came

out successfully carried out a resection in a case of strangulated hernia. He also was a large-hearted Irishman, and in reporting the case to the medical society said "Gentlemen, this patient owes her life not to Murphy of Sunderland but to Murphy of Chicago." At that time this experience represented very truly the position all over the world for there can be no doubt that there was a great wave of success attending the introduction of his method. Personally I still feel most grateful to the Murphy button, for my first case of successful intestinal resection in 1902 for an irreducible intussusception in a boy of nine, was carried out by its aid.

The button had many wonderful features. The absolute hæmastasis which it ensured was a feature that made it invaluable in carrying out cholecystenterostomy, and it was well suited for uniting the end of the dilated small intestine to the large intestine after resection of the cæcum, and I see that for this purpose a return to it has been made in the Mayo Clinic.[1] The great feature about the button was that it furnished a simple method which could easily be learned and carried out by any careful surgeon. Its very ingenuity and simplicity encouraged a trial and there can be no doubt that its introduction gave a great impetus to intestinal surgery. It certainly held the field against all other methods while the simpler and, as we think better, methods which we now employ were being evolved. The technique of modern surgery is far removed in its details from the methods employed in Lister's day, and yet all the plans on which we now rely for making operations safe are in direct descent from those of its founder, and are still a tribute to the master mind that made modern surgery possible. So it is with the Murphy button, for practically all we know of modern intestinal surgery is a direct result of the experience gained from its use. We should venerate and not disdain the steps by which we rise.

True the button appeared to be often unsuccessful, but the bad results as I look back —and I have a very clear recollection of that period—were for the most part dependent not on the device, but on our ignorance as to the various factors which underlie successful interference in gastro-intestinal surgery. Surgeons had a long road to travel and they did not understand the importance of those principles which were so adequately discussed by Professor Wilkie in the last Oration. So far as bowel growths were concerned the importance of mobilization was not realized, and I frequently saw growths called inoperable which I now know could have been safely removed if they had been properly mobilized. Frequently the bowel ends were brought together under too great tension so that union by whatever method could have no possible chance of success. Above all we had not learned the important bearing of obstruction, and even today it makes me shudder to recall the many occasions on which I have seen surgeons endeavoring to carry out resections and make anastomoses in the presence of gross obstruction. The recollection of those days is like a nightmare, and in unhappy dreams I still see the distended toxic intestine, the bright yellow escaping fæces, the purse-string suture cutting through the rotten wall, and the unsuccessful efforts of the surgeon to tuck in pieces of foul œdematous mucous membrane around the button, and I now know that no method of intestinal approximation could have carried these cases to a successful issue.

It was years before surgeons learned that no resection should be carried out in the presence of obstruction, and that in such cases a two-stage interference was essential to give the patient a reasonable chance of recovery. The latter is now generally recognized so far as gross obstruction is concerned, but I am not satisfied that sufficient importance is paid to the lesser and more insidious form of obstruction that so commonly occurs with bowel growths. In the Annual Oration of the Medical Society of London in May 1929, I referred to the 142 cases in which I had been able to carry out a resection of some portion of the large bowel for cancer. Of these cases, 72 were operated on by the two-stage method and the preliminary drainage reduced the mortality by a little more than half. Most surgeons deplore the fact that they do not get the opportunity of carrying out operation in cases of cancer of the colon until obstruction

[1] Collected Papers of the Mayo Clinic, 1925.

has developed. I attach such great importance to drainage of the bowel that I welcome this complication because it puts the matter beyond all doubt and the patient gets the great advantage which preliminary drainage confers, so that I have now come to look upon obstruction as a fortunate accident rather than an unfavorable complication. My series of colon resections goes back for many years, and includes my early work as well as many heroic adventures when multiple resections were carried out. With more experience and newer knowledge the mortality is down to 14.28 per cent but this is much too high and I look with confidence to a reduction to something like 5 per cent. This I feel sure is to be attained not by any unfair selection of cases, but by paying more and more attention to the lesser degrees of obstruction, and by an extension of the principle of the multiple operation. Recent mortality must be laid at the door of the one-stage method, and here I would say that the safety valve cæcostomy made at the same time as the resection is never so satisfactory nor so helpful as the preliminary cæcostomy which has been allowed to function satisfactorily before the resection is attempted. The ideal at which we ought to aim is not to do the most brilliant and perhaps spectacular operations, but so to manage our cases by the wise exercise of the art of surgery that in the words of Murphy "we can bring the case to a favorable termination with the least hazard or risk to the patient, regardless of our personal or professional feelings or of the praise or condemnation of our conduct."

To the principles dealt with by your orator of last year I would add the principle of adequate exposure, if necessary by the employment of oblique or transverse muscle cutting incisions directly over the growth (Fig. 4).

With the application, then, of these principles—mobilization, de-tension and adequate exposure—it is possible to carry to a successful issue the most extensive resections of the large bowel (Fig. 5).

Then many of our surgeons at that time were quite unfamiliar with the method of using the button, for they had not the opportunity of following the footsteps of its inventor and practicing on animals. Unhappily this has hampered our efforts continually and we have to admit that we in Britain are still in the position which the practical German visualized when he said that one must experiment in any event, and that one avoids experimenting on man in precisely the measure that one can experiment on animals (Flexner Report, 1912). Of course there were cases in which the button was responsible for some accident leading to the death of the patient, as in my second case of gastrectomy. Unhappily the patient died on the ninth day as the result of intestinal obstruction followed by peritonitis and caused by the impaction of the button. But these accidents did not deter Murphy and only led to the introduction of another type of button, an oval one, which I still believe to be admirable for gastro-enterostomy.

The Murphy button should be in every surgical museum and should be labelled "A mechanical device for securing approximation and anastomosis of the hollow viscera. Though now almost entirely superseded by the method of direct suture, its use introduced a new and successful era in gastro-intestinal operations, and did more than anything else to place this branch of surgery on a secure footing." This device was first described by him in a remarkable paper read before the Mississippi Valley Medical Association on October 15th, 1892, and which appeared in the *Medical Record* for December 10, 1892, under the following title: "Cholecysto-intestinal, Gastro-intestinal, Entero-intestinal Anastomosis and Approximation without Sutures." In this communication Murphy describes how he was led to devise the button to overcome the great difficulties which had been experienced by those pioneer surgeons who had endeavored to establish an anastomosis between the gall bladder and the bowel in cases of persistent obstruction of the common bile duct.

After describing the mechanism of the button and its method of use, he writes characteristically: "It takes about as long to describe the operation as to perform it. The time occupied with the first lady on whom I operated was 11 minutes from the entering of the peritoneal cavity to the closing of the same." This paper is based on a large amount of experi-

mental work carried out on 33 dogs, as well as examples of clinical experience of the method (Fig. 6). I have no hesitation in calling it an epoch making paper. In the world of letters there is a publication entitled "Great Short Stories of the World," and I would like to suggest that in connection with Medicine in its widest sense, it would not be amiss for someone with the leisure and aptitude to collect some of the epoch making papers that have appeared during the last century, and to publish them as a volume "Great Medical and Surgical Papers of the World." In such a volume several of Murphy's papers would appear, but none would occupy a more prominent place than his contribution to the surgery of intestinal anastomosis.

MALIGNANT DISEASE

"The patient is the centre of the medical universe around which all our works revolve and toward which all our efforts tend."

J. B. Murphy.

"Where there is everything to lose one must dare much."

Even in high quarters it has been so usual of late to bemoan or even decry the results of the operative treatment of malignant disease that many members of the profession are deterred from advising interference. There is a real risk of a generation arising who are ignorant of what surgery can offer in the treatment of cancer. While earnest investigators the world over are still probing into the mystery of the causation, countless sufferers are clamoring to be relieved and it is our duty to use the art of surgery to its fullest extent for their benefit. This was never absent from Murphy's mind and he emphasized our duty in the words from his presidential address which I have placed at the head of this section.

In the treatment of malignant disease the ideal and the practice are still far apart. John Hunter stated the position very clearly about 150 years ago, and the instance has been recorded by Stephen Paget in his delightful life of that great surgeon. Hunter was once asked to meet a cancer curer. He said that he had no objection provided that it was to be for the benefit of the patient. When they met, Hunter said to the quack, whom he knew very well, "Now, Jack, what are you going to do for this tumor, are you going to so alter the constitution of the parts that it will disappear, or are you going to remove it?" "Oh," said the blustering fellow, "I am going to destroy it." "Very well, then," Hunter replied, "That is nothing more than I or any other surgeon can do with less pain to the patient." This story is pregnant with wisdom, and until we succeed in discovering some remedy which will *so alter the constitution of the parts that malignant tumors will disappear*, we must be content to use those methods which we have learned to rely upon for their local removal or destruction. Though we cannot as yet attain the ideal, it is our duty to use the art of surgery to the utmost of our power for the relief of sufferers from this dread malady. Today radium and roentgen therapy have proved to be wonderful remedies, both are a great menace to cancer, but in their use both are as yet largely tentative and experimental. In connection with the extravagant claims which are still so frequently made for these remedies, it is interesting to note what Murphy wrote in 1915 on this matter: "The attack of hysteria, public and professional, concerning their curative potency, is subsiding, and their limited sphere of efficiency is being recognized" (Introduction to *General Surgery*).

In order to decide the real place of radium in the treatment of malignant disease, much more work is necessary and more precise information must be accumulated. For the most part sufficient experience is not yet available nor has sufficient time elapsed to enable us to say finally what radium can do in various situations and in the various types of growth. Until the indications for treatment by these remedies are better defined, we must not give up methods which are well tried, and it behoves all surgeons carefully to collate their results and to make them available for the guidance of the whole profession. At the present time we are living through one of those periods in which the profession and the public is encouraged to grasp at remedies which hold out some hope of cure or alleviation without mutilation, and it was never more necessary to have in our ranks strong

men of the Murphy type, with wide experience and balanced judgment, who can authoritatively determine which cases can reasonably be selected for such conservative methods and which must be treated by thorough and not half-hearted surgical efforts. The history of the surgery of malignant disease is neither so discouraging nor so discreditable as many would have us believe, for it shows that when the efforts of the surgeon have been well planned and *have been sufficiently thorough*, the results have often been commensurate with the sacrifice which the patient has had to make. In my own personal experience there is no place for pessimism in the treatment of cancer by surgery. The degree of success which we attain is extremely encouraging and when we fail we must remember the inevitable mortality which represents the alternative. When success has just been missed, we must ask ourselves if we might not have obtained a happier result by acting a little differently. Apply the Murphy scourge, "What else might we have done? What else should we do next time?" The indications which we receive from pathological workers like Broders point to a not distant time when it may be possible to estimate accurately what we conveniently call the "malignancy" of any growth. To be really valuable it must be possible to make such an estimate before the plan of treatment is decided, otherwise the method becomes merely a guide to prognosis. So that as yet, in most situations in the body, and in most types of cancer, the chief reliance must still be placed on excision, and the best hope for the sufferer lies in a properly planned and executed operation. Murphy realized this very well, and in his writings he constantly deplored the half-hearted attitude of the profession toward the early and thorough treatment of malignant disease by the knife. Such an operation must still aim at removing the whole of the diseased part with a wide area of healthy tissue, and the path of probable malignant invasion. The best illustration of an ideal removal of this sort is the complete breast operation as introduced to the profession by your W. S. Halstead so long ago as 1890. As a result of a most elaborate and careful scrutiny of the after results that punctilious surgeon was able to state that when cancer of the breast can be treated radically before the axillary glands are involved, two patients out of three may be expected to be cured. No results by any method of treatment have ever surpassed this achievement.

Some things are hard to say, and it is often easier and pleasanter to leave them unsaid, but that was never the way with Murphy, and in this oration to his memory I dare not shirk the responsibility of stating how often operations for malignant disease are inefficient, both in conception and execution. My greatest criticism is that too much attention is perhaps paid to the attempt to attain the ideal and completely remove the cancer path, while somewhat neglecting the equally, or more, important thorough removal of the local disease. In malignant disease of the abdominal viscera, operation is often surprisingly successful when the circumstances appear at first sight to be unpromising. Years ago I learned that in the absence of undoubted evidence of dissemination, the patient deserves the chance that operation alone offers. The wisdom of this rule has constantly been illustrated in my practice, and I never regret its application. Unfortunately, an inspection with the abdomen opened often discloses unexpected dissemination, but on the other hand it is surprising how sometimes the unpromising case turns out to be operable. That we are so frequently unable to detect secondary deposits in the liver until that organ is under visual inspection or palpation remains a reproach and one fervently hopes that some dye selective for cancer and opaque to X-rays will soon be discovered. The burning zeal of a Murphy might fathom this secret, which has proved as yet securely hidden. As good evidence of the truth of my guiding rule, I could give you many instances and several have been quoted by me in the "Oration on Cancer of the Colon," which I delivered before the Medical Society of London in 1929, and elsewhere (*Encouragements in Cancer Surgery*, 1925).

A case in which I removed the whole stomach for cancer a year ago is an apt illustration. The woman was extremely ill and anæmic, and there was a large, craggy mass in the

epigastrium, but there was no certain evidence of dissemination, and as rather a forlorn hope it was decided to operate. Laparotomy disclosed the fact that the disease was limited to the stomach, which was removed (Figs. 7 and 8), the œsophagus being united directly to the duodenum.

The surgical treatment of malignant disease of the stomach has always especially interested me. When I had the great privilege of serving as house surgeon to Rutherford Morison, he was enthusiastically carrying out the pylorectomy of those days with very encouraging results, and at the time of what proved for me a memorable first visit to the Mayo Clinic 25 years ago, I was fascinated by the operations for stomach cancer, which William Mayo so beautifully carried out. In our Newcastle cases in the old days the immediate results were very good, but early recurrence usually followed. When this happens in cancer most people accept the discouragement as inevitable; they take the cup with its darker draught (Omar Khayyám, stanza XLVIII) and from tacitly agreeing that operation may be followed by recurrence, it becomes usual to say that recurrence is to be expected and operation is discouraged! First surgeons said they could not get the cases early enough, but when by chance they did get patients with small tumors, their operations were still too frequently followed by recurrence. Then it was said that too little stomach was sacrificed and heroic excisions became the rule and so much was taken away that a direct anastomosis could not be made, and Billroth II became the usual operation. But when we followed the advice of Shakespeare to

> *"Enter his chamber, view his breathless corpse and comment then upon his sudden death."*
> *Shakespeare—Henry VI.*

the study of recurrences showed us that as often as not the disease did not return in the stomach wall at all, but in the liver or in the glands. The former eventuality could scarcely be guarded against, but the latter gave some guidance as to the conduct of our operations. That the fear of glandular involvement is the real crux is borne out by the after history of cases in which the growth has been situated in the body of the stomach, for in this situation the gland bearing areas can be more readily removed, and the results are correspondingly improved. I show you illustrations from cases of patients who survived for over 8 years (Figs. 9 and 10), and my colleague, the late Mr. Albert Martin of cartilage fame, removed a recurrence from the abdominal wall of a patient on whom he had performed gastrectomy 12 years previously. So with these encouragements as guides to surgical conduct, we have learned to take more care with each individual case and to avoid standardization of our gastric resections, and the results have been much better. Mindful of Bernard Shaw's paradox "The golden rule is to remember that there are no golden rules," each case is approached on its merits, knowing that we must so plan our attack as to remove a wide area of healthy tissue around the growth, which means the removal of the lymphatic glands surrounding the pylorus, with as much as possible of the path of probable cancer invasion.

In operating for cancer of the stomach I never allow myself to think of a radical cure, for cancer in this organ is undoubtedly of a high grade of malignancy, and a survival of from 3 to 5 years is about as long as we dare expect. In my experience gastro-enterostomy in stomach cancer has been most disappointing, for so often as William Mayo said many years ago, it merely "enables the patient to live longer and suffer more." Further it has been attended by a much higher mortality than gastrectomy and there has been far more trouble in convalescence. Gastrectomy, on the other hand, even when not permanently successful, is a very satisfactory palliative for stomach cancer. Look at the illustration (Fig. 11) of the stomach from a man on whom I carried out partial gastrectomy with little prospect of success. As the illustration shows the growth was very extensive and the line of section had to be made close to it. To my surprise he not only made a good recovery but lived and worked for 5 years in sound health, when symptoms of recurrence declared themselves and proved fatal 9 months later. In dealing with cancer we must be ever bold, remembering the mortality if surgery fails,

and with courage do what we feel to be right. Growths of the colon provide some of the most promising results in the whole field of cancer surgery (Figs. 12, 13, 14, and 15), and it is delightful to count among our successes patients alive and well 15 or more years after operation, or those where death has carried them off in their declining years—then a solemn rather than a sad event (Paget)—from some other disease or degeneration and without any return of a cancer removed long years before. To be successful, nay to do his duty to his patients, a doctor must have faith in the remedies he employs. This truth has been recognized from time immemorial, even in the days of charms, for had not Friar John a charm good against bullets, which, however, was no use to him because he didn't believe in it! This is particularly true in dealing with malignant disease for unless surgeons believe that *cancer at its inception is a localized disease*, they will not do much good for their patients.

Every experienced surgeon must be familiar with clinical evidences of the local nature of many cancers. Five years ago I removed a mass of axillary glands infiltrated with cancer of the scirrhus type, secondary to this disease in the breast which had been removed 25 years previously by the old type of operation. My colleague, Mr. John Clay, excised some secondary malignant glands 15 years after the removal of a primary growth from the lip. Recently I had the care of a man of 70 suffering from obstruction due to growth in the lowest part of the sigmoid. Twenty years previously I had assisted at the removal of a cancer of his rectum by the old type of perineal excision then in vogue. The large bowel furnishes many examples of this localization, but I know of none better than that shown in the illustration (Fig. 16) which exhibits a growth of the sigmoid infiltrating the small intestine which is perforated by three holes, nature's attempt at a lateral anastomosis. The patient was a woman of 65 who gave a history of 4 years abdominal colic, with one year of diarrhœa and loss of weight. Death unhappily occurred after an operation for the removal of the growth, but this furnished an opportunity of making a complete examination and no sign of dissemination could be found.

This tendency to localization in the abdomen gives surgeons the opportunity of carrying out many double or complicated resections with great prospect of success (Figs. 17 and 18).

In connection with the operative treatment of malignant disease of the rectum it is splendid to contemplate the results in cases like those the specimens of which I show you (Figs. 19, 20, and 21), patients who are alive and well 18, 16, and 15 years after successful excisions and who may reasonably be expected to be beyond the probability, though not the possibility, of recurrence of their disease. But such operations are of necessity mutilating, and in the pursuit of ideals it behoves the surgeon to endeavor to explore the art of surgery to discover methods which will enable him to preserve the wonderful sphincteric mechanism with which a beneficent Creator has endowed his peoples, surely one of God's greatest gifts to man. So far as the rectum is concerned, diagnosis is undoubtedly the keystone of the problem, and we can never expect to get as good results as we ought, and surgery will never have its best chance, until we can be assured that patients reach us at an earlier stage. In a series of 80 cases that I investigated, the average duration of symptoms before surgical treatment was undertaken was no less than 9 months. This question of diagnosis was always very prominent in Dr. Murphy's work, and he used to get very wrath, and used some of the most devastating invectives when talking of the delay so often made in arriving at a diagnosis of cancer. He referred to this matter again and again up to the end of his life, as will be seen from the last introduction he wrote for the General Surgery Volume of the *Practical Medicine Series* in 1916. It is often urged that the public ought to be educated in the early signs of malignant disease, and this view was strongly held by Murphy, who was in favor of utilizing the services of the press for this purpose. I venture to suggest that the better and better education of our profession comes first. We must all be aware of many instances in which the diagnosis of, say, malignant disease of

the rectum, has been made regrettably late because of the neglect of one of the most ancient and simple examinations. What a dreadful indictment since we know that 65 per cent of rectal growths occur within easy reach of the finger! In dealing with cancer of the rectum it has for long been the British practice to carry out a very radical excision and this type of operation has been followed by an encouraging degree of success, both immediate and remote, and with a wide range of operability. In my own series 39.21 per cent of patients thus treated have passed the 5 year period without recurrence.

But this operation means the sacrifice of the sphincters, with the inconvenience of either a sacral or inguinal anus. Nearly 30 years ago I was greatly impressed by the possibilities of a conservative operation which I saw carried out by two of my colleagues, and which aimed at the thorough local excision of the growth, with restoration of the canal and preservation of the sphincters. The particular operation which I witnessed was successful in its immediate result, but was followed by early recurrence, and this I fear was the result in most of the other cases in which that operation was essayed at the time. These disappointments led British surgeons to conclude that the more extensive and mutilating operations were alone justifiable, and attempts were made to what is called "standardize" the operations. Personally I have a great distrust of so-called standardization in dealing with human beings and pathological conditions. I had rather be guided by the teaching of one of the best and wisest doctors it was ever my privilege to know, the late Dr. Andrew Smith of Whickham, who said that "our knowledge should be based on sound pathology so that in unusual cases we may be able to act on true principles rather than routine." Both patients and diseases vary, and cases should be treated more on their merits, but this means more study of the individual case. In some few the growth in the rectum is diagnosed so early that it is found sufficiently localized to make it possible to do a thorough operation in keeping with those principles which guide us in dealing with malignant disease generally and yet without sacrifice of the sphincters. My first chance came in the case of a woman 30 years of age suffering from intractable syphilitic disease of the rectum, which had resisted all forms of treatment. I was able to resect 4 inches of the affected portion of the bowel and to make an anastomosis, with the satisfaction of securing perfect restoration of rectal function and

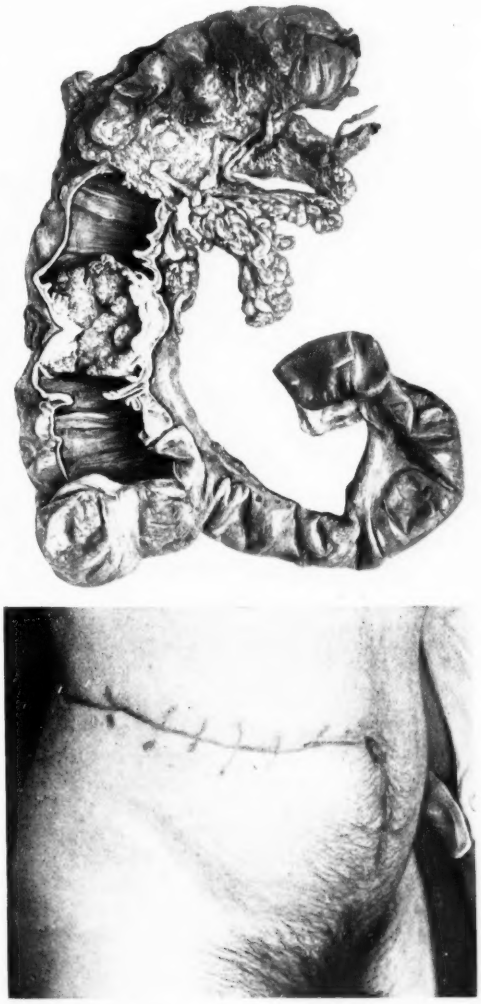


Fig. 4. Carcinoma of the ascending colon densely adherent in the right loin. The transverse incision shown in the photograph made the resection straightforward and recovery was uneventful.

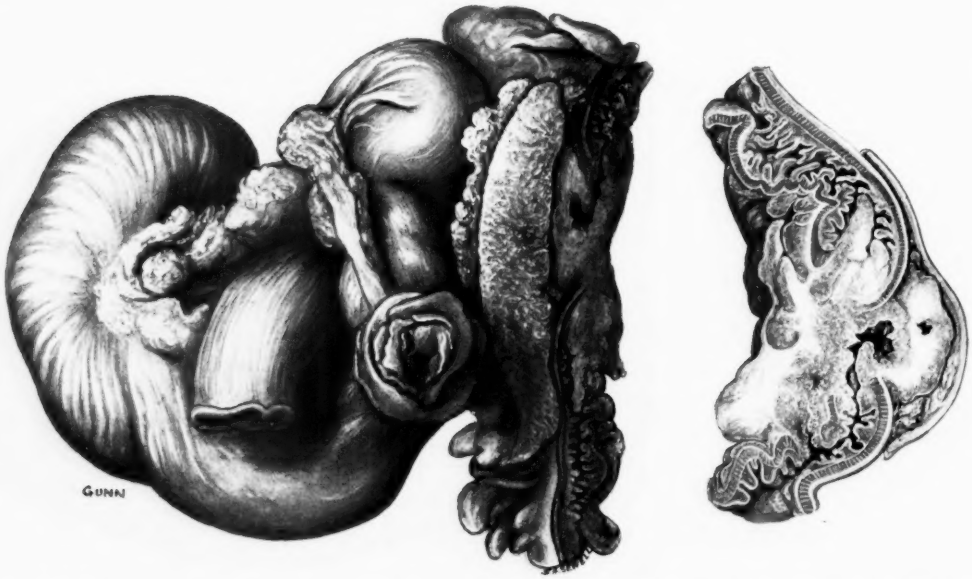


Fig. 5. Carcinoma of the sigmoid involving the abdominal wall and coils of small intestine. There were also secondary glands in the groin. Successful removal with restoration of continuity of the bowel. Preliminary drainage by cæcostomy. Recent case. The smaller drawing shows the growth in section.

sphincteric control (Fig. 22). This patient lived in great comfort until her death took place some years later as the result of a cerebral gumma.

After this success I longed for an opportunity of carrying out a similar operation in a case of malignant disease. This finally arrived in the year 1919, in the case of a very intelligent man of 55, whose first symptom was rectal hæmorrhage, for which an equally intelligent medical friend advised him to consult a surgeon at once. When I saw this patient a growth could be felt within easy reach of the finger, and on inspection with the sigmoidoscope it was seen to be about the size of a shilling and freely movable with the mucous membrane. A piece was removed for microscopical section and its malignant nature confirmed. The patient was a big, bulky man who would not for one moment contemplate the possibility of a permanent colotomy. Without delay an exactly similar operation was carried out, and the part of the rectum which I show you was excised, through a posterior incision with removal of the coccyx (Fig. 23). In spite of minor complications the patient ultimately made an excellent recovery and now, nearly 11 years afterward, is alive and well without any suspicion of recurrence, and with perfect rectal function and control.

Another most successful case was a female patient aged 44, who came under my observation in the summer of 1922. In her case the growth was about the size of half-a-crown situated in the ampulla of the rectum (Fig. 24). A colleague, in whose opinion I had the greatest confidence, had seen the patient and had advised her that the complete radical operation should be carried out, but the patient would not hear of the prospect of an incontinent sacral anus, or of a colotomy, and I had to accept the responsibility of deciding whether or not a purely local operation would be justifiable. I concluded that it would be proper to make the attempt because of the very short history, the position of the growth, its limitation to one side of the bowel, and the fact that it could be freely moved with the

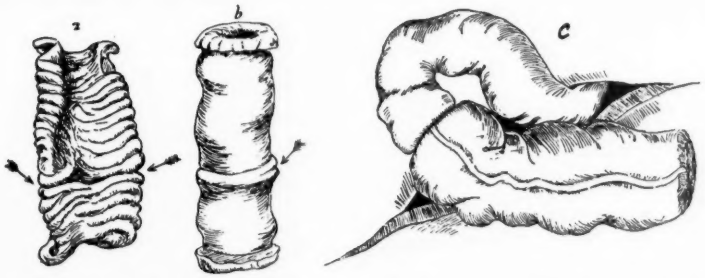


Fig. 6. From Murphy's original paper on the button. a and b, Appearances of mucous and serous surfaces of bowel after union. c, Result after joining end of small to end of large intestine (excision of cæcum). (From the *New York Medical Record*, 1892.)

mucous membrane. There are no special features to remark about the operation except to say that I performed it after a preliminary colotomy, which was subsequently closed. The patient made an uninterrupted recovery and, at the present date, over 8 years since the operation, is in good health and free from any suspicion of recurrence and with perfect restoration of function.

In the hands of experienced surgeons this conservative operation appears to me to be justifiable when the growth can be easily reached and explored in every part by the examining finger, and when it is movable with the mucous membrane so that, independently of the patient straining, it can be rocked from side to side on the deeper wall of the bowel. Of course there must be no suspicion of dissemination. As a rule in my cases the first symptom to attract the attention of the patient has been hæmorrhage, there has been a comparatively short history, and the growth has tended to be of the papillomatous type. So far as I am concerned the technique of this method is now fairly well established, though I am not yet prepared to dogmatize as to all its details. In its general plan the operation, as I have carried it out, is that described by the late Professor Kocher of Berne, and generally known by his name. Preliminary colotomy, though helpful in some ways, is not without disadvantage. Perhaps temporary cæcostomy would fulfill the indications equally well, but neither of these preliminary operations is essential for the success of the resection and they are indicated only if there is definite obstruction. Many of my cases have done equally well without. Actually in my series of 17 cases I have done a preliminary colotomy in 7, and in one it was required afterward to enable a sacral sinus to heal. The incision is a vertical one from the middle part of the sacrum to near the anus. It is usually necessary to excise the coccyx. The aim of the operation is to divide the bowel just above the upper edge of the internal sphincter, to remove the affected portion inside the levatores ani and to divide the bowel again at least 2 inches above the upper limit of growth. In order to carry out the latter step it is often necessary to open the rectovesical or Douglas's pouch. The bowel ends are then united by direct suture. Sometimes the lower limit of the growth is unexpectedly found to be so near the upper edge of the sphincter that it is impossible to remove a sufficient margin of healthy mucous membrane below it. Under these circumstances I deliberately split the sphincter posteriorly right through the anus and remove the whole of the mucous membrane of the anal canal. The upper end of the bowel is then brought down through the sphincter and attached to the anal margin, the vertically split sphincter being carefully repaired with sutures of interrupted catgut. The development of an operation of this sort is of great interest and importance, and will be completed in all its details only by those who are dealing with numbers of cases frequently. Experience must be added to experience before the lessons learned are dimmed by lapse of time.

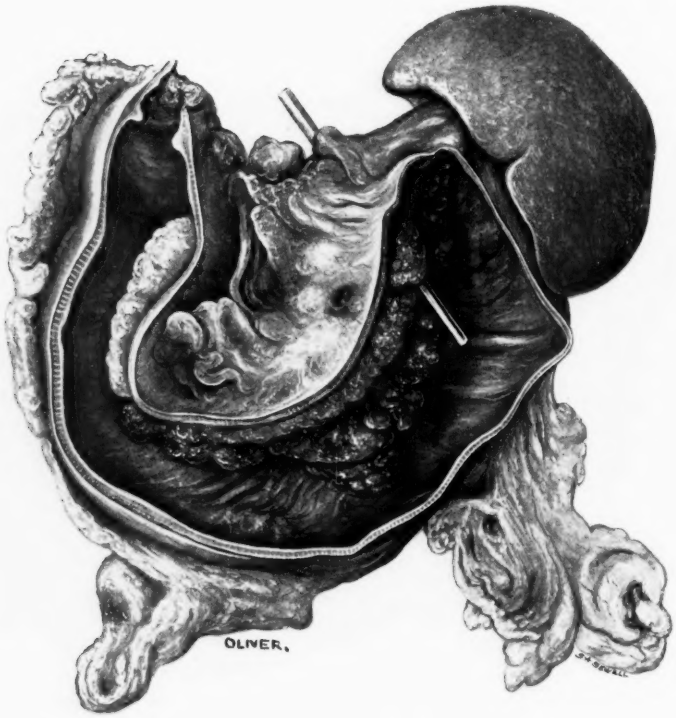


Fig. 7. The whole stomach and spleen which was removed for carcinoma of the lesser curvature. The œsophagus was united directly to the duodenum by suture. The glass rod has been passed through the œsophageal opening and traverses the growth. The patient made an excellent recovery, was able to enjoy ordinary food taken in small quantities at a time, and to attend to her household duties. She died a year later following an operation for the relief of small intestine obstruction. At the postmortem examination no dissemination was found. (See also next figure.)

In order to establish the value of such a method, we require exact and detailed information about the cases, and that is just what is so frequently lacking in our case reports, and is where much important work can be done by anyone who will take the time and the trouble. If only our young men would be content to follow the advice of St. Paul and "condescend to things that are lowly" what a wealth of material they would find at their very door!

I have now operated on 17 patients by this conservative method, in every case with restoration of sphincteric control. In 3 cases the condition was not malignant and the results were admirable (Fig. 24A). Of the remaining 14, one was a sarcoma, and the remainder carcinomatous. In 2 cases there was recurrence within a year and colotomy became necessary. In another case it was recognized that there was no prospect of cure by any type of operation, and therefore the conservative method was deliberately employed as a palliative because of the horror—borne of experience in the person of a relative—which the patient entertained for colotomy. The functional result was excellent; a small local recurrence yielded to radium, but death occurred from abdominal dissemination, 1 year and 9 months after the operation. Another

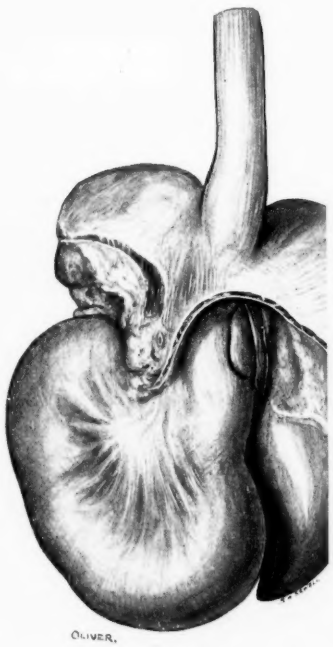


Fig. 8. Specimen obtained after death from the previous case. The drawing shows the direct anastomosis of the œsophagus to the duodenum. The parts have been exposed from behind.

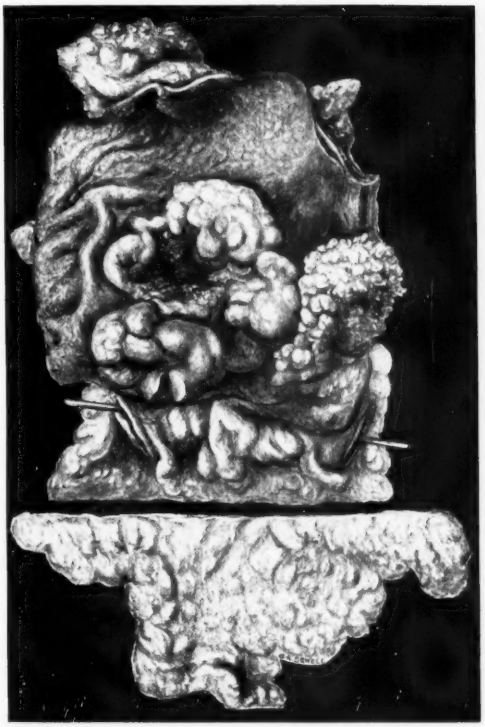


Fig. 9. A large carcinoma originating in the body of the stomach near the greater curvature. It was excised together with the middle portion of the transverse colon (indicated by the glass rod), which was infiltrated by growth. The great omentum was also removed. The patient was well for 8 years, when she showed signs of recurrence in the liver, which proved fatal a few months later. (Note the papilloma near the pylorus—probably the carcinoma started in a similar growth. The stomach has been laid open along its posterior surface.)

died of apoplexy 3 years after operation, but without any suspicion of recurrence. Of the 10 remaining patients:

1 is alive and well 11 years after operation
1 is alive and well 8 years after operation
3 are alive and well 4 years after operation
5 are alive and well within 3 years of operation.

Some of these cases are worthy of special remark. One patient was a woman 74 years of age, and in her case it was necessary to split the sphincter vertically and to excise the mucous membrane of the anal canal. Healing was slow but she ultimately made a complete recovery in every way and remains well more than 4 years after operation (Fig. 25). In another case the patient, a man of 63 years, was the subject of long standing diabetes. In the first instance abdominal exploration, followed by colotomy, was carried out because it was considered unlikely that he would tolerate any more extensive interference. To my surprise he made so good a recovery that the conservative operation was subsequently carried out and eventually the colotomy was closed. In this case a much larger section of bowel was removed than in any of the other cases (Fig. 26). He is now in good health, 4 years later. Sphincteric control is perfect but his rectum is not so sensitive a reservoir as in the other cases, and it commonly contains fæces of which the patient is unaware. None the less he is happy, useful, and extremely grateful.

Another of the patients was a young man of 26. In my country, and certainly in my

Fig. 10. Carcinoma of the stomach involving the transverse colon. Double resection with restoration. Patient lived for 8 years in complete comfort when death occurred without suspicion of recurrence.

own experience, operations for rectal cancer at this age however heroic have usually been followed by early recurrence or dissemination. I therefore thought that the patient would have as good a chance with the more limited excision, and I am glad to say that he is now quite well, more than 4 years after operation (Fig. 27, see also Figs. 28, 29, and 30).

In contrast to the large bowel and the rectum, cancer of the mouth has long been recognized as peculiarly malignant and prone to resist our best efforts for its amelioration. But all mouth cancers are not the same and in some the results of operation have been surprisingly good. At present this is a field in which we are hoping much from radium, though the time has not yet arrived at which we can always stay our hand and say that if radium fails nothing remains to be done! It is a delight to be able to offer some relief to these abandoned cases by a thorough local removal, and the results are sometimes most encouraging. I rejoice to see from time to time patients on whom I have operated in this way 7, 8, 9, 10, and 12 years ago (Fig. 31), and more recent cases have furnished great encouragements. I show you half the lower jaw of a man (Fig. 32) removed merely as a palliative over a year ago. It was a most unpromising looking case and I nearly declined to interfere. He is now well and happy and has "what all good men desire, enough work to do and strength enough to do it" (Kipling).

In these extensive resections of the jaw with the tongue or floor of the mouth, Kocher pointed out long ago that the prognosis was much worse when the mechanism of deglutition was interfered with, and Professor Sir William Macewen stressed the same point. In this connection I want to bring to your notice the application of the principle of short circuiting, or exclusion, and the two-stage operation. When the resection must of necessity interfere with swallowing, the plan of

Fig. 11. Carcinoma of the stomach, sub-total gastrectomy. Patient made a good recovery and remained well for 5 years when symptoms of recurrence appeared which proved fatal 9 months later.

making a temporary gastrostomy has proved most effective and helpful. I am accustomed to carry it out 2 or 3 weeks before the operation on the mouth, and at the same time I may remove carious teeth, etc. It not only removes the difficulty and discomfort of feeding, but does away with the dread of that process and much of the unavoidable sepsis associated with it. This plan, which I first used about 10 years ago is much appreciated by the nursing staff, and I have no hesitation in saying that it has greatly diminished the mortality (Figs. 33 and 34).

Even when used merely as a palliative for cases of malignant disease of the mouth in which removal cannot be contemplated, gastrostomy often brings much relief and may enable "death to put on some kind disguise" (Don Quixote) for the patient may gradually fade away or develop a low form of pneumonia which carries him off while he experiences great relief from the gastrostomy. Is it not our mission "to help those to die we cannot help to live" (Munthe)? The resistance to cancer undoubtedly varies, but the factors underlying this variation are ill understood. Personally I remain convinced that fear or dread greatly diminishes the resistance to cancer.

What greater encouragement can we have than the contemplation of the case of the old man whose picture I show you (Figs. 35 and 36)? Ten years ago, when 67 years of age, I removed the front of the jaw and the floor of his mouth for an epithelioma which had commenced in the gum. It was only expected to be a palliative operation, but 4 years later he returned quite well as regards the mouth, but with symptoms of rectal cancer. A permanent colotomy was made, and a sacral excision of

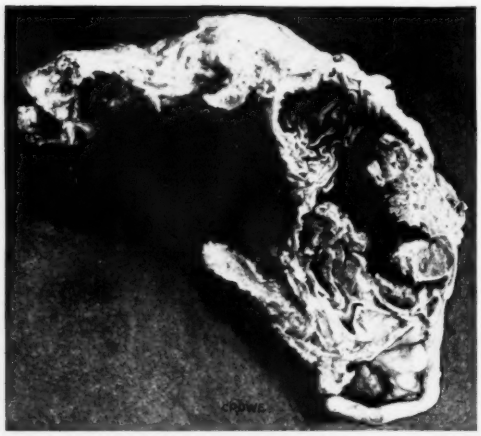


Fig. 12. Carcinoma of cæcum. Patient alive and well 16 years after resection.

the rectum carried out, and he now remains well and happy, a fine specimen of courage and determination.

Now let me refer to another type of malignant disease, in order that I may tell you that in my experience the results of the energetic and thorough treatment of sarcoma are not so uniformly mournful as many people believe. Years ago I was greatly impressed by the case of an old lady who developed sarcoma of the right upper jaw 22 years after the opposite one had been successfully removed for the same condition. Since then I have learned to expect good results following excision of the upper jaw, and have patients alive and well 3, 5, 8, and 10 or more years afterward. These better results I attribute to the more deliberate operations which preliminary laryngotomy or intratracheal methods of anæsthesia allow. The illustration (Fig. 37) shows a favorable type of sarcoma so far as prognosis is concerned and the patient is alive and free from recurrence now, 26 years after operation. A much more active growth was that in the case of a girl aged 13 years from whom I removed a rapidly growing sarcoma of the vastus externus muscle 10 years ago, and a recurrence 2 years later (Fig. 39). Today she is alive and well and able to follow her occupation (Fig. 40). In this case as in others operated upon for sarcoma, I have employed prophylactic

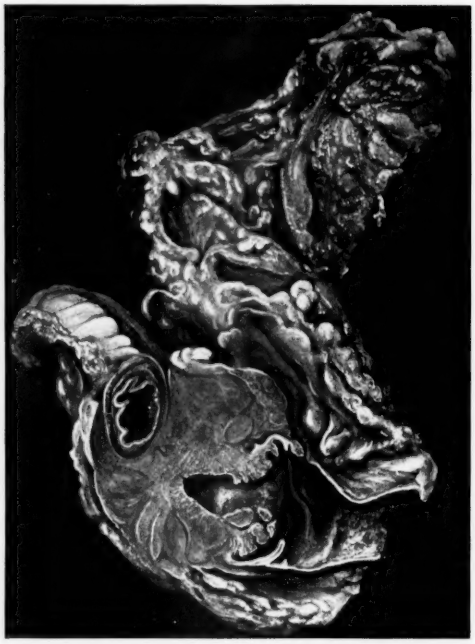


Fig. 13. Carcinoma of the cæcum. Patient alive and well 15 years after resection.

doses of the mixed toxins of your Dr. W. B. Coley, for a period of 2 years after the operation. I am glad to have this opportunity of saying how much I admire his persevering advocacy of a method of treatment which I have always believed to be most valuable.

THE SURGERY OF ANKYLOSIS

"The results we have obtained have been most gratifying, not only to us but to the patients, and it is the patient who must be considered."

Arthroplasty. J. B. Murphy. Annals of Surgery, May, 1913.

Raffaele Bastianelli, in his oration for 192[illegible], dealt with Murphy's work on the surgery of the joints. His papers on this subject are admirable and especially the one from which I have quoted because by that time he had come to such definite conclusions and most of all because he illustrates his work by such excellent case reports that the reader can judge for himself. I have watched the development of this branch of surgery with the greatest interest, and I have no hesitation in saying that

Fig. 14. Carcinoma of the ascending colon. Resection in two stages; patient alive and well 15 years afterward. The intussusception was incidental and had no bearing on the case.

if Murphy had never made a stiff joint move he would still be entitled to the greatest credit for focusing the attention of the profession on the subject of joint infections and their consequences. As was his wont, he reviewed the whole question and went into the pathology of the infection of joints and was thereby led to deal largely with the methods for the prevention of ankylosis. In the treatment of established ankylosis he encouraged interference in such a way as to impel the conscientious surgeon to try his plan in many cases in which he might otherwise have been content to leave matters alone! He insisted that none but a skilled and experienced surgeon should undertake this work, and then only after having performed the operation repeatedly first on the several joints of the cadaver and secondly on animals. But he was ready to admit his failures and I was much struck by this during my visit to his clinic at Rush Medical College, for there he frankly admitted that he had utterly failed in a case of ankylosis of the knee in which perhaps it would have been better to have left matters alone. But great awards await surgeons and patients who have the courage to venture on this operation. I want to bring before your notice the case of a patient, J. B., who first came under my care in 1911 when he was 18 years of age. This lad had a bony ankylosis of the right elbow, the result of an acute osteitis of the humerus which in turn followed a primary acute staphylococcic osteitis of the left tibia which had commenced 6 years previously. After dealing with sequestra both in the tibia and in the humerus, a Murphy arthroplasty was subsequently carried out on the elbow. A focus of

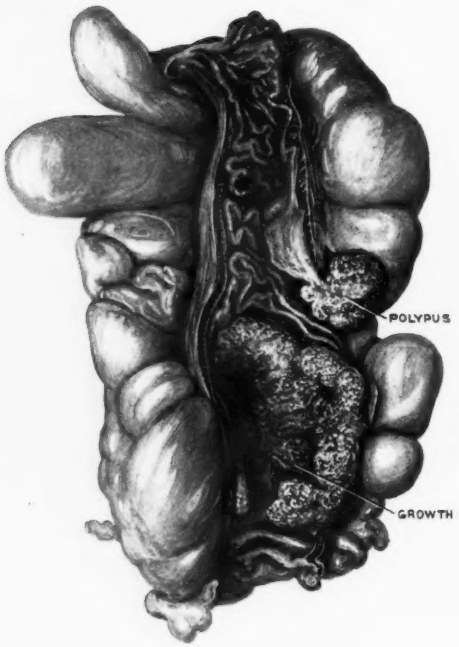


Fig. 15. Carcinoma of the pelvic colon in an enormously fat person. Removal with permanent colotomy; patient alive and well 8 years afterward.

residual sepsis was opened up and probably in consequence an acute infection of the wound occurred. Despite such unfavorable auspices

Fig. 16. Carcinoma of sigmoid infiltrating the small intestine and with three holes communicating with the latter, a natural entero-anastomosis. Patient, a woman of 65 years, gave a history of 4 years colic with 1 year of diarrhœa and loss of weight. Death occurred after resection and on postmortem did not show any evidence of dissemination whatever.

recovery was complete and after some months he was able to return to work. Since that time he has suffered now and again from an outburst of sepsis in connection with the original focus in the tibia and once in the region of the elbow, but these have caused only temporary disability.

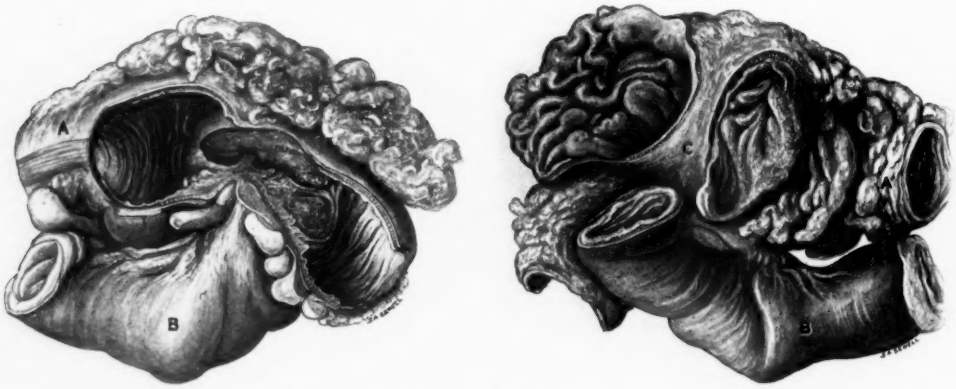


Fig. 17. Carcinoma of the splenic flexure involving the small intestine and stomach. A two-stage operation with triple resection was followed by recovery. Three years later the patient died from another cause and at the postmortem no evidence of dissemination was found.

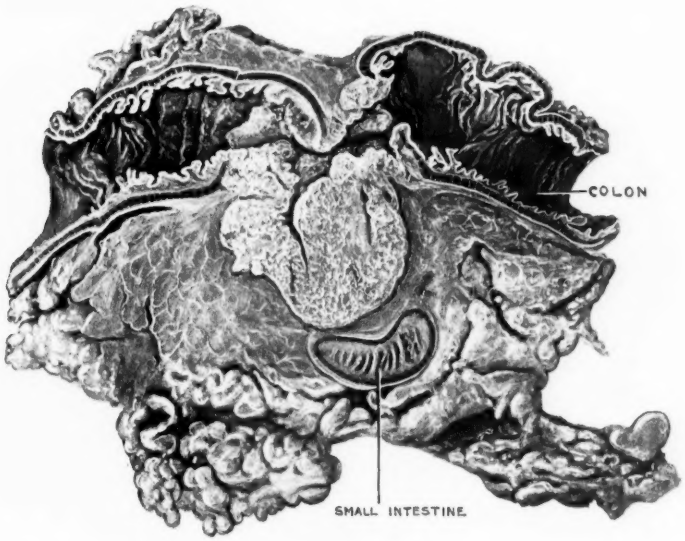


Fig. 18. Carcinoma of the transverse colon involving the small intestine and the abdominal wall at the umbilicus where there was a fæcal fistula. Resection with restoration of bowel. Patient alive and well for 9 years and 4 months when she died of nephritis without any evidence of recurrence.

His work as a foyboat man entails the constant use of his arm in the management of his craft and in handling heavy ropes and climbing up and down ladders. Now, 17 years after the arthroplasty, his arm remains as good as ever (Fig. 41). He is regularly at work and winter and summer spends his time rowing about the river. About a year ago he was set up with a new boat, and we must take it as a subconscious compliment to Murphy that he has christened her "SUCCESS"!

Clearly every case should be treated on its merits, and there cannot be any general rule as to when a surgeon should interfere, but as a result of Murphy's work we all of us now view the subject in quite a different way and in a much more rosy light. In one important field I think this method has been much neglected, and I would strongly urge that more attention should be paid to arthroplasty in dealing with ankylosis of the finger joints, which often has so great an economic importance. I have always thought that it was greatly to the credit of my friend Hybbinette, of Stockholm, that he thought it worth while to demonstrate this operation before some British visitors. To my mind it does not in the least belittle Murphy's work to admit that it is not always necessary to use the fascial graft. In dealing with ankylosis of the jaw, for instance, I have found that it is only necessary to remove a sufficiency of bone to secure a lasting good result. The illustration (Fig. 42) shows the left temporomaxillary joint 8 months after I had carried out an ordinary excision, i.e., without interposition of fascia, for bony ankylosis originating in a septic arthritis of aural origin. The patient was a lad of 18 who died of acute nephritis. The picture shows the wonderful restoration of the joint, the bony surfaces closely simulate the normal contour and were covered by a layer of what looked like articular cartilage.

In this matter it was not so much Murphy's own work as the light he focused on the whole subject, and what he stimulated other surgeons to do. But the lessons about the early stages of infection of the joints and their treatment which he strove so hard to drive home are very necessary at the present day.

Fig. 19. Carcinoma of the rectum removed with a portion of the vaginal wall by the lower route. Patient, a hard-working woman, is alive and well 18 years afterward.

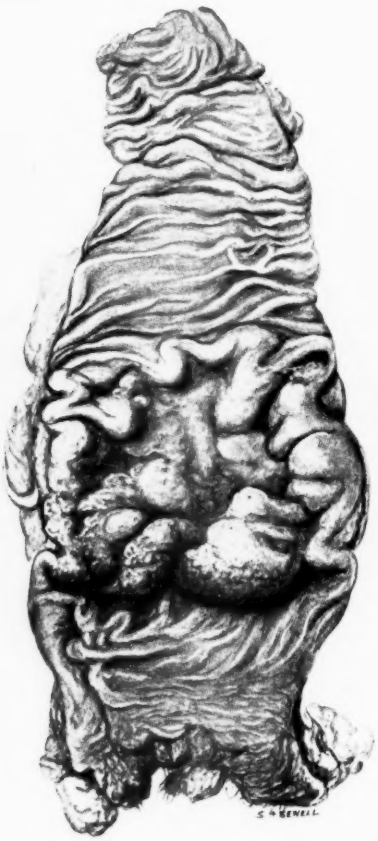


Fig. 20. Carcinoma of rectum. Excision by lower route after preliminary colotomy. Patient is free from recurrence, now 16 years after the operation.

I want to direct your attention to a class of case in which an acute infection of a joint may come on insidiously and with few signs in the early stages. Our conception of septic arthritis is usually of an acute disease with a definite and very painful onset, and pursuing a rapid course. The features and importance of the milder types are not sufficiently emphasized in the textbooks. How much better would it be if these works for the guidance of youth could be illustrated by short, accurate notes of cases! I believe Murphy had such a work in mind, if he was not actually engaged on it when the great Reaper cut off his activities. It is most important that the whole profession should realize that these mild cases do occur, that they are apt to be mistaken for rheumatism or growing pains or perhaps for early tubercle, whereas an infection which usually goes on to destruction or ankylosis is really the case. Further, it cannot be too clearly realized that at a stage at which the diagnosis should be made and treatment commenced the X-ray does not help, and repeatedly shows a normal joint contour. The case of a lad of 14 who came under my observation in 1927 was a very striking example. He was admitted to hospital on June 3, complaining of pain in the left hip with inability to walk. The trouble first came on gradually while he was at work 8 days previously. At the beginning it was just like a twitch when walking, but 2 days later it became continuous. On the day of admission the boy

Fig. 21. Carcinoma of rectum involving the prostate. Excision by the lower route after preliminary colotomy. A slice of the prostate, the seminal vesicles, and the terminations of both vasa had to be included in the excision as shown on the reverse of the specimen. There was a urinary fistula which took 6 weeks to close. The patient is now alive and well, and free from recurrence 15 years after operation.

vomited, he had fever of 102.8 degrees F. and looked correspondingly seedy, but he made little complaint and described his trouble merely as a stiffness in the joint which developed during the night but disappeared on movement during his waking hours. At that time the physical signs were so slight as to be overlooked save by the most experienced and vigilant observers (like hospital sisters of long service who certainly deserve this description). At that time, and as late as a month afterward, the X-ray was entirely negative. While the patient was under treatment the signs became more and more definite, and in spite of care the condition went on to destruction of the upper epiphysis which was removed as a sequestrum on September 27 (Fig. 43). Only the significance of the history and of the clinical signs are to be relied upon, and this really brings us back to the question of teaching and emphasizes once again the extreme importance of actual contact with patients. No other method, oratorical, didactic, pictorial, even by moving picture, can demonstrate the slight limitation of movement, the protective rigidity which at once comes on when it is attempted and the guardian attitude of the patient toward the lesion in his joint. Nor can pictorial methods show the slight but progressive deterioration in general condition, the fretful intolerance of even gentle examination, the scarcely visible engorging veins, and the slight obliteration of the hollow over Scarpa's triangle. These vastly important signs can be learned only by repeated observation at the bedside. The importance of early treatment in these cases can scarcely be over-stressed for, as Murphy said "the acute arthritides . . . are surgical lesions from the very first day." The prognosis is always serious and doubtful, but the results will be best if adequate extension is employed from the outset. Murphy's work was just a little obscured for English readers by his constant reference to "Buck's extension." We in England are not familiar with any apparatus

Fig. 22. Syphilitic stricture of the rectum. Conservative resection; patient made a good recovery with complete restoration of function.

by that name, though it only refers to the method of weight and pulley extension which now seems universal and should be taught to all students for the apparatus can be so easily applied and treatment with it carried out in the homes of the people.

Fig. 23. Early carcinoma of rectum. Conservative resection, perfect function. No recurrence for 11 years.

Fig. 24, left. Conservative resection of the rectum for carcinoma. The patient, a woman of 44 years, is alive and well and with complete restoration of function more than 8 years after operation.

Fig. 24A. A papillomatous condition of the rectum treated by conservative resection. The bowel has been turned inside out the better to show the growth.

Fig. 25. Conservative resection of rectum for carcinoma. Patient, a female aged 74 years. Specimen shows mucous membrane of anal canal. The sphincter was divided vertically and the bowel brought down to the anus. Complete restoration of function. Patient alive and well 4 years after operation.

Fig. 26. Conservative resection of the rectum for carcinoma. Man, aged 62 years. The patient was a diabetic but made a good recovery and is now well with restoration of function more than 4 years after operation.

CLINICAL RESEARCH

"I have but one lamp by which my feet are guided, and that is the lamp of experience. I know of no way of judging the future but by the past."

Patrick Henry.

"Truth is not the child of authority, but of time."

Lord Bacon.

Murphy by his life work showed how much could be done in the way of purely clinical research, and in that respect alone his example proved an abiding stimulus to a great many of us whose activities are dictated by the insistent claims of practice, whether inside or outside hospital walls. With the living patients as the pivot for research, all may take heart of grace for clinical problems are never

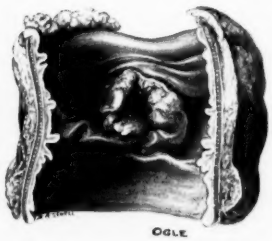


Fig. 27.

Fig. 28.

Fig. 29.

Fig. 27. Carcinoma of the rectum. Conservative resection; patient a young man of 26 years is alive and well more than 4 years after operation and with perfect restoration of function.

Fig. 28. Conservative resection of rectum for carcinoma. Man, aged 51 years. Includes mucous membrane of anal canal. Perfect restoration; patient alive and well 2 years after operation.

Fig. 29. Sarcoma of the rectum. Conservative resection; the actual growth has prolapsed from the bowel. The specimen shows the relationship of the rectovesical pouch to the bowel removed. Recent case.

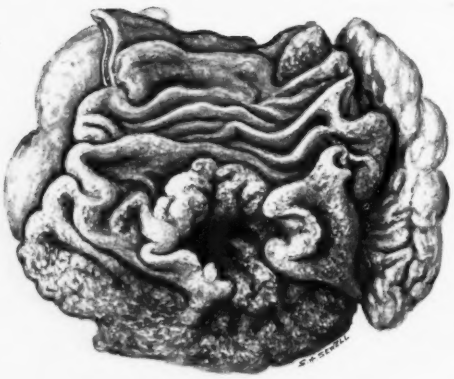


Fig. 30. Conservative resection of the rectum for carcinoma. Man, aged 45 years. Alive and with perfect restoration of function 4 years after operation.

ending and there will always be an immense amount of work to be done on these lines. Among the cases which I demonstrated when Dr. Murphy visited Newcastle, was that of a girl, aged 18, with tuberculous glands in the right groin which had made their appearance after excision of a portion of the lower ileum and cæcum for a tuberculous lesion. At the abdominal operation a large mass of glands was found in the mesentery (Fig. 44), and they could not all be removed with the bowel. The patient made an excellent recovery, but during an unexplained period of lowered resistance about 2 years later, the groin glands appeared and when shown before the visiting surgeons there was a large mass along Poupart's ligament. As the result of general treatment her condition steadily improved and the glands slowly disappeared. She then remained perfectly well for 15 years when symptoms of intestinal tuberculosis recurred and led to her death—an apt illustration of the long period during which tubercle bacilli may lie dormant. There were many interesting features about this case, but the patient was really shown to raise the interesting question of the focus of infection of tuberculous glands in the groin, and I then made the suggestion that in the great majority of such cases the infection arises from the mesenteric glands. This was quite contrary to the general teaching, for most authorities then, and indeed now, assume that in these cases there is an external tuberculous skin lesion on the foot or leg, and that the groin glands are infected therefrom. The evidence of this source of invasion is quite unconvincing and I myself have never found such a skin lesion in the several cases of tuberculous groin glands with which I have had to deal. In any situation an external infection of a wound or abrasion with tubercle is a very rare event and when it occurs it can scarcely be overlooked. In 30 odd years I have seen only two undoubted cases, one of the lip and another of a finger; both were unmistakable, and were accompanied by tuberculous lymphangitis as well as tuberculous adenitis. They ran an acute course and in both thorough and timely operative removal of the focus and its consequent mischief was necessary. The same doubt arises with regard to the origin of tuberculous glands in the axilla and the same unsatisfactory explanations are still offered. With the exception of the very rare tuberculous affections of the breast, I have never found a local focus of infection for these axillary glands and abundant evidence goes to show that in the majority of cases their focus is also in the mediastinum or mesentery. Of course, the evidence of the site of invasion is not always obvious and we may have long to wait for confirmation of what we believe to be true and have often to piece history and clinical observations together. The general question of the focus of infection in tuberculous glands has always interested me, and the patient shown to Dr. Murphy led me to set out on a piece of clinical research in the hope of discovering some principles which would be a guide to our practice in dealing with these cases. I had endeavored to glean guidance from the literature but like Omar Khayyám

> *"Myself when young did eagerly frequent*
> *Doctor and Saint, and heard great Argument*
> *About it and about; but evermore*
> *Came out by the same Door as in I went."*
> *The Rubaiyat, Stanza XXVII.*

When I first commenced to take an interest in surgery, some 35 years ago, it was the usual custom to operate on nearly every case of tuberculous glands, whatever their situation.

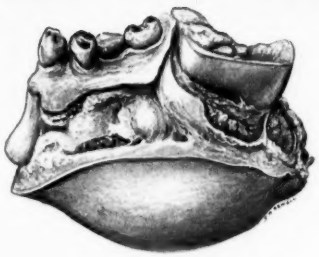


Fig. 31. Three views of a patient 11 years after excision of the tongue for epithelioma, and 6 years after removal of the left half of the jaw for recurrent glands which were adherent to the bone. The second operation was carried out after preliminary gastrostomy. The small drawing shows the portion of jaw with the mass of adherent growth.

As a rule the surgeons of those days made the most beautiful dissections and took the greatest possible care in the exercise of the art of surgery for the cure of their patients, but the results were extremely variable. Sometimes the patient would have no further trouble, the scar would be little obvious, and everybody would be satisfied but oftener than not, as soon as convalescence from the operation was satisfactorily over, another group of glands would make their appearance. Usually the so-called recurrence was looked upon as an indication for further vigorous surgical attack. This would necessitate general anæsthesia for an hour or often two, there would be considerable blood loss in the aggregate and much shock. As a result the original focus would be further encouraged in its activity and before the poor patient had recovered from the effects of this surgical onslaught,

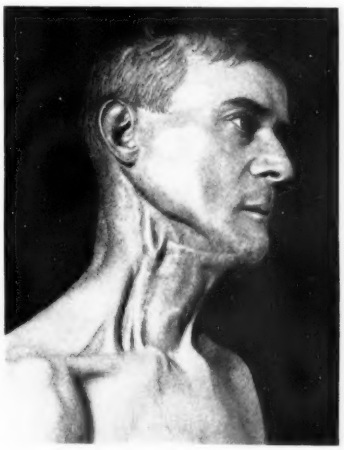
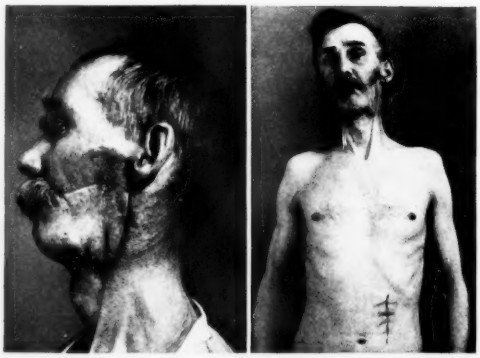


Fig. 31A. Patient 8 years after removal of the anterior third of the tongue for epithelioma. The glands were affected and a complete Crile's operation was carried out.

Fig. 32. Epithelioma of the alveolar margin invading the jaw and with secondary glands adherent to the latter. Palliative resection. Patient alive, well, and comfortable more than 12 months later.

yet another group of glands would become enlarged, and would sometimes be as energetically attacked. Finally the patient would

Fig. 34. Epithelioma at root of tongue involving posterior part of floor of mouth. Specimen of a portion of jaw with mass of secondary glands and sternomastoid muscle. Operation 2 weeks after preliminary gastrostomy. Patient made uninterrupted recovery. Recent case.



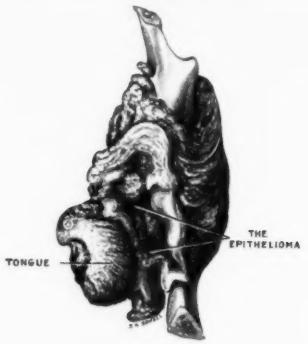


Fig. 33, above. The scar after excision of the growth shown in the next figure. The operation was carried out after preliminary gastrostomy. The patient made an entirely uninterrupted recovery.

Fig. 33A. Portion of jaw from the previous patient. It shows the epithelioma involving the alveolus, the floor of the mouth, and the back of the tongue.

go downhill and not infrequently developed symptoms of general tuberculosis which often proved fatal. The experience of Denys, that wise and lovable character in "The Cloister and the Hearth," seems aptly to illustrate the matter when he expostulated to Gerard:

"When a soldier bleeds from a wound in battle these leeches say 'Fever, Blood him!' and so they burn the wick at t'other end too. They bleed the bled. Now at fever's heels comes desperate weakness; then the man needs all his blood to live; but these prickers and burners, having no forethought recking nought of what is sure to come in a few hours, and seeing like brute beasts only what is under their noses, have meantime robbed him of the very blood his hurt has spared him to battle the weakness withal; and so he dies exhausted. Hundreds have I seen so scratched and pricked out of the

Fig. 35.

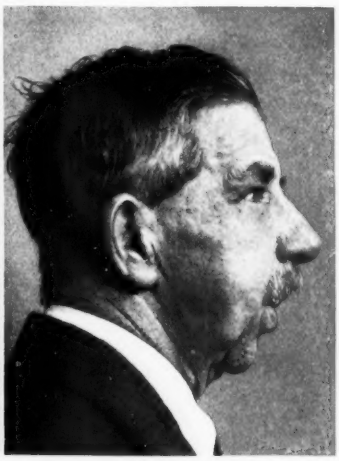


Fig. 36.

Fig. 36A.

Fig. 35. A man of 74 years of age, 10 years after removal of the front of the lower jaw and floor of mouth for epithelioma (specimen in left hand) and 4 years after excision of the rectum for a double growth (specimen in right hand). Patient is now alive, well, and cheerful.

Fig. 36. The same patient as in previous figure. It shows the small amount of deformity in profile and the portion of jaw removed 10 years ago.

Fig. 36A. Drawing of specimen.

world, Gerard, and tall fellows too; but lo! if they have the luck to be wounded where no doctor can be had, then they live; this too have I seen."

Because of the lack of uniformity in the results of surgical intervention, as well as the many bad results, it became the fashion for many surgeons and doctors alike to decry radical surgery and to employ niggardly interference, or to advocate non-operative treatment. In view of the frequent disappointments following surgical intervention this was not an unreasonable attitude. Since that time, and usually following the dictates of fashion, rather than the guidance of pathology, all sorts of treatments have been carried out, and these have varied from medicines to sea-air, from sea-air to vaccines, from vaccines to X-rays, from X-rays to sunlight, either real or artificial, and from this to radium, etc., etc. But the results have still been uncertain and extremely variable, some cases doing well and others being palpable failures. I have constantly pointed out to my pupils that though under very diverse methods of treatment tuberculous glands may disappear, clinically there is no evidence that the bacilli are killed, and I tell them that it is like the

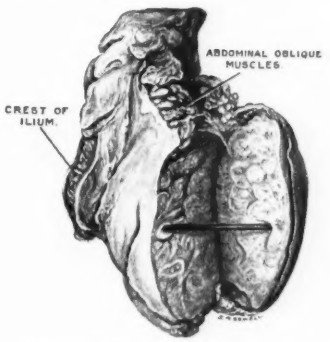
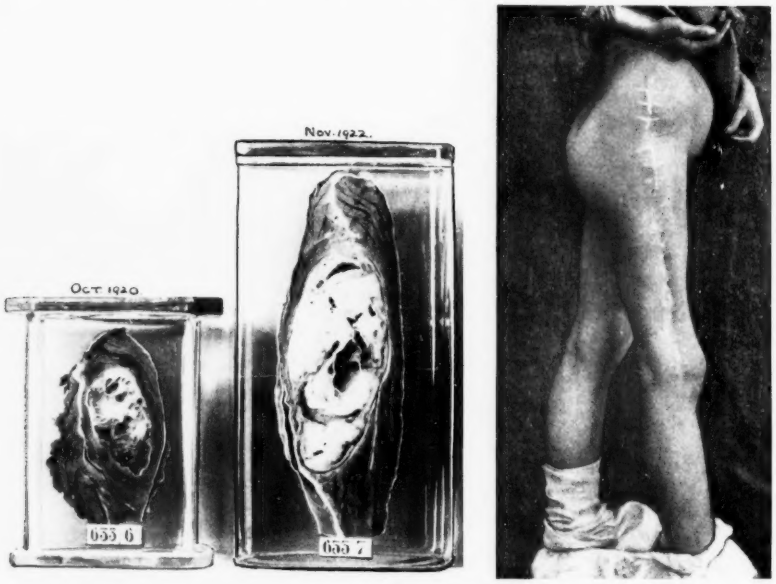


Fig. 37. Spindle celled sarcoma of abdominal wall. Excision with part of crest of ilium; patient alive and well 26 years later.



Figs. 38, 39, and 40. Recurrent sarcoma of the vastus externus muscle. The first growth was removed in October, 1920, and the recurrence in November, 1922. On the latter occasion the whole of the affected muscle was removed. The incision required is shown in the photograph on the right. The patient is now alive and free from recurrence 10 years after the first operation.

gravestones in country churchyards, which are set up to remind us that those whom they guard are "not dead but sleepeth" (Fig. 45). Even calcification is not a sure sign of dissolution. I have repeatedly seen glands "cured" by these various methods, subsequently become active, and give rise to such manifestations as to necessitate surgical interference. In many cases as one sees them today, the most desperate efforts have been made to avoid surgical interference, too often with the result that abscesses have formed and have not infrequently been incised and secondarily infected. The children of tuberculosis officers and of physicians have furnished evidences of the failure of the methods which they employ. It may be that the good results far outweigh the bad, and that I see only the failures, but if that is so the latter must indeed be common! Of course there can be no doubt that the most diverse methods of treatment may lead to temporary amelioration, but it is the permanence of the results which experience has led me to doubt. I am fully alive to the necessity for continuity in our methods for the treatment of tubercle wherever it occurs, and have always taught that to be successful these methods must be employed until long after the patient is clinically cured and not for a stated number of months or even years. In the dilemma as to what was the best course to adopt when asked to assume the responsibility for the treatment of patients with enlarged glands, I pursued the Murphy method and asked myself the question "What is the reason for all this variability—what can be the underlying pathology in these cases?" As the result of clinical experience, the abundant disclosures of the post-mortem room, and the long continued study of the after history of many cases, I am now prepared to submit that there are two great groups of cases in which the neck glands are involved in a tuberculous process. In the one group the infection is entirely local and arises in connection with the tonsils or the nasopharynx, or much more rarely with the teeth, and in the other group a primary infection of the mesenteric or

Fig. 41. Showing the result 17 years after a Murphy arthroplasty for bony ankylosis of the elbow joint. The patient's employment entails rowing about the river. The X-ray photograph taken at the same time shows the condition of the joint.

Fig. 42. Temporomaxillary joint 9 months after removal of the condyle for bony ankylosis. The functional result was satisfactory. Patient died of acute nephritis.

mediastinal glands is the cause. In the nasopharyngeal group the primary focus can be dealt with and if this is not promptly followed by the complete disappearance of the glands, these ought to be removed by a well planned dissection. Cases in which the focus is in the mediastinum or mesentery are in quite a different category. There the enlargement of external glands is an evidence of the breakdown of the general powers of resistance and the first essential is to re-establish the latter. If the local glands do not yield to these measures it may be necessary to interfere surgically, either to deal with broken down areas or to excise completely a group of glands, but no such interference must be attempted until the general resistance has been encouraged in every way possible.

So that whereas in the nasopharyngeal group a radical operation is the ideal and proper procedure, in the mesenteric group it is not the first essential but may be a necessary adjunct. The continued observation of cases over a number of years entirely supports this view of the essentials of treatment. For instance, in a series of cases traced for many years, there were 63 of the nasopharyngeal group in which the glands had been removed by a complete dissection, and only one, or 1.58 per cent, developed a tuberculous lesion elsewhere and died. On the other hand, in a series of 20 of the mesenteric group no less than 55 per cent had developed tuberculous lesions elsewhere and of these 45 per cent had died of tubercle. These cases had all been carefully watched and none of the patients in either group had been operated upon for less than 5 years when the investigation was carried out.

This conception of the origin of tuberculosis of the glands which I have tried to put before

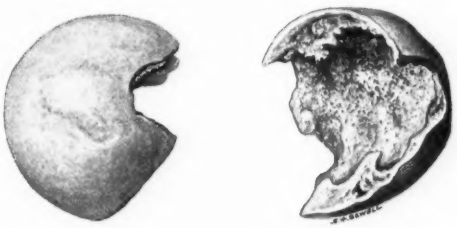


Fig. 43. Upper epiphysis of the femur removed as a sequestrum 116 days after the onset of a subacute type of arthritis.

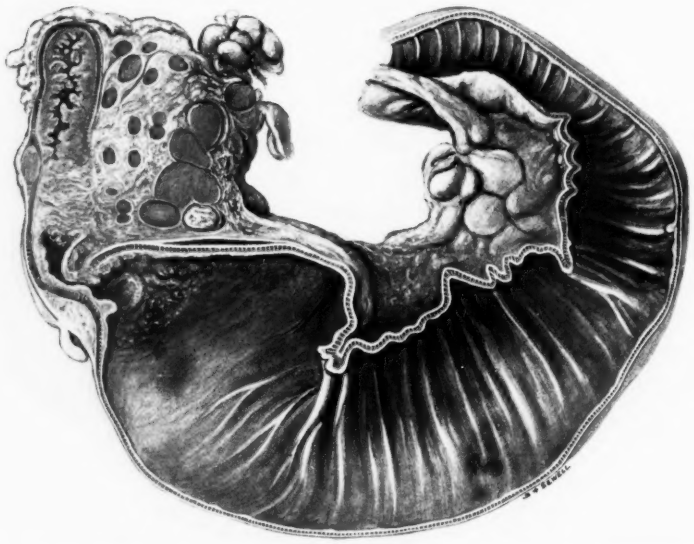


Fig. 44. The lower end of the ileum excised with the cæcum and the corresponding mesentery. The cæcum is the seat of tuberculous disease and the glands in the mesentery were extensively involved by the same process. The dilatation of the ileum was due to chronic obstruction. The patient, a girl aged 18 years, made a good recovery from the operation and enjoyed excellent health until 15 years afterward when death occurred from recrudescence of tuberculous disease in the small bowel.

you has received abundant confirmation from increasing clinical experience. I believe it to be accurate and I have found it to be of the greatest help in the management of these cases, so that, with it as a guiding principle, order has come out of chaos.

CONCLUSION

"The more the World changes, the more it remains the same."

Another reading is still more apt and we may say "while the times change man is always the same," and the older one grows in the knowledge of medicine, the more one realizes how true is this with afflicted humanity. So far as teaching is concerned this knowledge should help us and hearten us, for it surely shows that the methods which produced a Murphy are still good to produce men of the same caliber for tomorrow. His best education was that obtained by being brought into intimate contact with disease at an early stage in his career, and throughout life his education was carried out on the same clinical lines. There is a serious tendency to endeavor to apply the methods of mass production to the making of doctors, but that will not do. There never was a subject in which it was more necessary to get in close touch with realities, and for this purpose, while the principles are being taught, clinical teaching must be decentralized and must be largely individual. So far as undergraduate teaching is concerned, I want to say a word in favor of the British system, in which, by our dresserships and clerkships, our students, at a comparatively early stage, are brought into close contact with actual patients and have themselves an opportunity of making repeated and leisurely examinations and of verifying the diagnosis about which they have been told. This feature of our education impressed the writer of the Flexner Report of 1912, who commented as follows:

"The English are indubitably correct in holding that sound medical training requires free contact of

the student with the actual manifestations of disease."

As I think of Dr. Murphy, and his extraordinary knowledge of surgery in all its forms, I cannot help feeling that he was the product of this sort of training, and it was probably because he felt the great necessity for this actual contact with disease that he devoted himself so whole-heartedly to teaching. I do plead for more clinical work and for the study of disease by the side of the patient. Continuity in teaching and observation is also all important and in this we cannot improve on the example of Murphy for he brought his patients before the class many times if necessary, so that his pupils were kept in touch with the elucidation of the various points. This is a plan which I associate in my mind with the clinic of Professor Kocher, and I sometimes wonder if both these great teachers learned the method in Vienna for they were both ardent disciples at the shrine of Billroth.

In his efforts to educate the profession, Murphy carried on the pioneer work of his own teachers, but education is a continuous process which must go on and on throughout the ages. It must ever be slow and laborious for both those to be taught and those who hold themselves responsible as teachers. I venture to suggest that the profession, and especially this great College of Surgeons, should set itself against attempts to arrive at medical education by easy routes. Clinical work cannot be learned by watching cinema demonstrations, and I have no hesitation in saying that, except in a very limited field, the cinematograph is a dangerous method if it is offered in place of the more laborious plan where the learner comes into direct contact with the patient. For post graduate teaching it may prove useful, and it is certainly the means of bringing before the eye of many what can only be closely observed by the few, but therein danger lies.

Murphy's life was an illustration of a continuous process of self-education, which John Stuart Mill said was "to question all things;

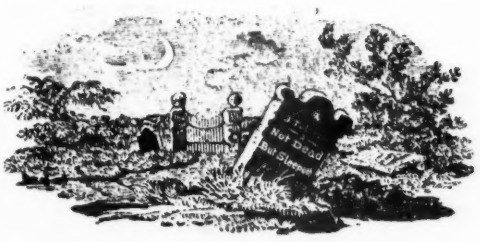


Fig. 45.

never to turn away from any difficulty; to accept no doctrine, either from ourselves or from other people without a rigid scrutiny by negative criticism." Can anyone doubt but that this was Murphy's daily task, and can we doubt its wisdom? Of easy routes to knowledge there may be many, but to wisdom none, and from the dim distant past on its way to the future comes the message "Wisdom is the principal thing, therefore get wisdom." But the task is not easy and for some of us seems impossible, but let all remember Murphy's message, "Only by infinite labor can competency be maintained."

"Does the road lead uphill all the way?
Yes, to the very End.
Will the journey take the whole long day?
From Morn till Night, my friend."

Christina Rossetti.

And now my task is at an end. It has been a great honor and privilege to deliver this, the eleventh, Murphy Memorial Oration, and a peculiar pleasure to endeavor to pay a tribute to the memory of a great surgeon and a great teacher, whose life will always remain an inspiration to us all. I am unable to guess why I have been selected for this privilege but I like to think that it is as a compliment to the Provincial School of Surgery to which I belong, a School that has given a Richard Lambert, a James McIntyre, a Yeoman Heath, a Frederick Page, and a Rutherford Morison as humble worshippers at the Shrine of Surgery, and I do not forget that Murphy once said that the best surgery is not all done in the biggest cities.

THE TREATMENT OF MALIGNANT TUMORS OF THE URINARY BLADDER[1]

HENRY WADE, C.M.G., D.S.O., F.R.C.S., EDINBURGH, SCOTLAND

A TUMOR or neoplasm has been defined as an autonomous and functionless growth of tissue, which possesses the power of apparent limitless growth and which originates from a single primary focus. The medical problem its presence thus presents differs from all other diseases, in that when once established it continues to grow; it excites no reparative response on the part of the tissues of the host, a natural cure never results. A cure can thus only be effected by removal or destruction of the growth, but before such is attempted whether the tumor be innocent or malignant the points to be determined are whether such is necessary and if so whether this is possible.

The innocent tumor remaining local may, under certain circumstances, be left undisturbed and the patient's health unimpaired by its presence, but if such a decision is come to it should be borne in mind that the innocent tumor always has in itself the potentiality of assuming the malignant characteristics of invasion, dissemination, and destruction. The innocent villous papilloma of the bladder, if left undisturbed, ultimately undergoes malignant changes. If removal is decided upon, the ideal treatment aimed at in the innocent growth is to remove it locally and entirely with the minimum amount of damage to the surrounding structures and without liberating any of the cells of the growth into the neighboring tissues. In malignant disease the ideal aimed at in operative treatment is to excise the entire growth, the entire organ in which it is situated, the lymph parts flowing from it, and the lymph glands draining it, complete and in one piece. Circumstances frequently render this ideal unachievable. The disability that results from the loss of the entire organ involved may be so serious to the patient as to justify less radical measures and the preservation of part of it. The warrant for this limited procedure, however, can be established only when it is demonstrated that this conservation is not followed by more frequent recurrence of the disease, or if recurrence does take place, the previous operation has not rendered impossible the ultimate achievement of a cure by radical surgery. If removal of the malignant tumor be impossible from the vital importance of the organ involved or the extent of the dissemination of the disease, in many cases surgery can relieve the suffering and prolong life by certain palliative operations; the beneficial effect of cerebral decompression in irremovable tumors of the brain is well known; the starvation of the patient which results from the mechanical occlusion of the channel in cancer of the œsophagus may be overcome by a gastrostomy; an inguinal colostomy for irremovable carcinoma of the rectum by resting the growth and preventing obstruction may be followed by as much as 7 years of relative comfort. The patient upon whom the operation of suprapubic cystostomy has been performed for irremovable carcinoma of the prostate may anticipate a further two years of life.

For the treatment of these cases which are considered inoperable from the standpoint of radical surgery, there is still available certain agents employed for tumor cell destruction. Many are employed, and the use of certain of them is occasionally advocated in preference to the use of the knife, but none of them are specific in destroying the cancer cells and leaving undamaged the neighboring healthy tissue. In radium we have the nearest approach to specific action. X-rays are of value occasionally. Coley's fluid in the hands of the expert appears to produce occasionally beneficial results. Treatment by lead, if it has not proved of much value in surgery, can at least have this said of it, that it has demonstrated what the ancient alchemist never achieved, it has shown how to transmute a baser metal into gold.

If the knife is set aside in the treatment of innocent or malignant tumors and a method

[1]Presented before the Clinical Congress of the American College of Surgeons, Philadelphia, October 13–17, 1930.

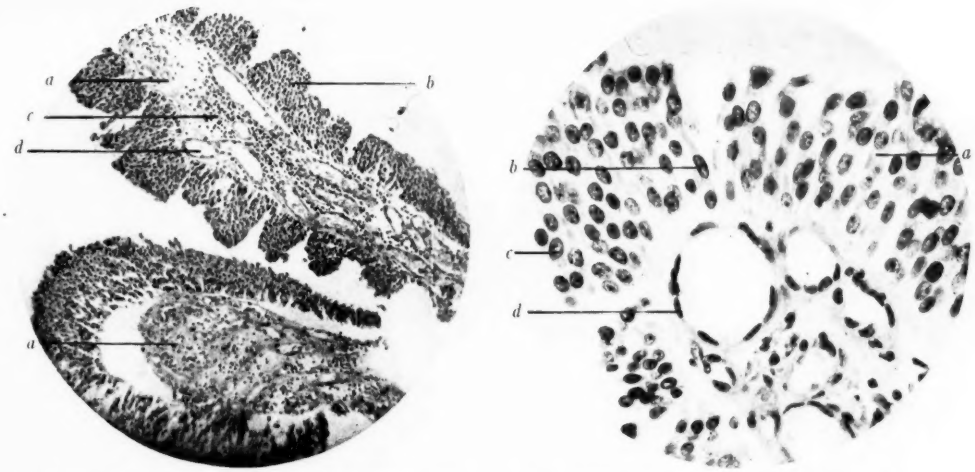


Fig. 1. A villous papilloma. The low power photomicrograph shows two papillæ, *a;* transitional epithelium, *b,* stratified and arranged radially to the connective tissue core. Fibrous tissue core, *c,* with numerous capillary blood vessels, *d.* The high power photomicrograph shows transitional epithelium with, *a,* radial arrangement and heaped up on connective tissue core; elongated type of epithelium *b;* nucleus with uniformly distributed chromatin, *c;* no hyperchromatosis; capillary blood vessels with their lining endothelium, *d.*

of cell destruction is substituted, it is necessary to establish clearly the reason for the substitution. If any or all of them possess properties superior to the method of excision, it follows that the knife should be permanently dethroned. Are there cancer cells which have properties rendering them peculiarly responsive to destruction by such agents? Certain facts suggest the possibility of this, as when one observes the response in a case of carcinoma of the tongue to treatment by radium, and hears of the success attending its employment in carcinoma of the cervix. Or are these successes due to the region treated being one where the discharge that results has the opportunity of a free escape? We will recommend the choice of the method of destruction by the high frequency current for fulguration in cases of innocent villous papilloma of the bladder, the reason being that in these cases it can be carried out through the unopened bladder, and the method is one which prevents dissemination of the tumor cells and their subsequent implantation, as is liable to occur with the open operation. As a means of treating malignant disease, however, it is not a curative agent.

In approaching the question of the treatment of malignant disease of the urinary bladder you have first of all to decide clearly what value you attach to the use of methods of tumor cell destruction as curative agents for cancer in this region. If you are convinced, or it is your experience, that radium or diathermy alone or in combination can effect a cure in a reasonable number of cases, it follows that you should employ them in preference to any other form of treatment, as by their use the bladder can be conserved as a functioning cavity to the comfort and peace of mind of the patient. I purpose advocating radical operative surgical treatment, as my experience up to the present is that radium does not cure carcinoma of the urinary bladder, and having viewed the distress of the sufferer from advanced carcinoma of that organ, having seen the agonies he endures from the recurring spasms of pain he suffers, which he tries unsuccessfully to relieve as they come on every few minutes by voiding a few drops of foul, fetid urine, I am convinced that radical mutilating surgery is warranted to improve or to cure the disease present.

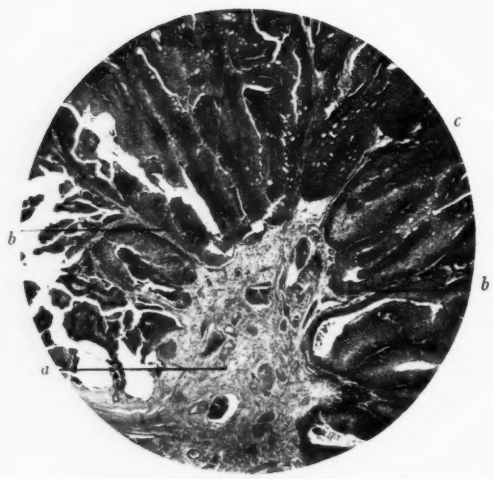


Fig. 2. A villous papilloma. The low power photomicrograph shows well marked primary core, *a;* with long fine subsidiary strands streaming away from it, *b;* epithelium, *c*, stratified, proliferated and deeply massed upon the fine strands. The right figure is a high power photomicrograph which shows one papilla with fine tenuous core, *a;* epithelium, *b*, which is massed deeply on the fine core.

When an individual enjoying good health develops hæmaturia which is sudden in onset, painless and profuse, it is probable that the cause of the bleeding is a villous papilloma of the urinary bladder. Here, as in every case of hæmaturia, a cystoscopic examination is indicated to determine the nature of the disease.

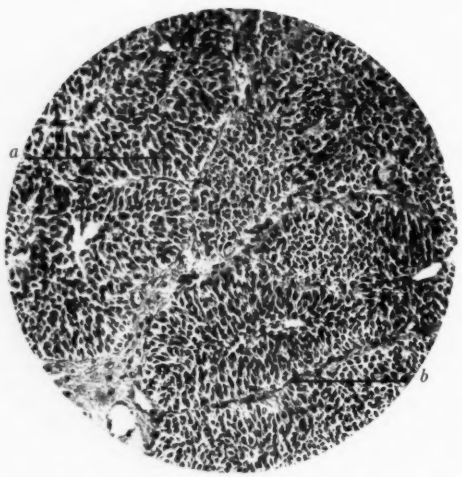


Fig. 3. A villous papilloma. Massing of villi, *a;* which are not free but have characteristic slender core, *b*.

If your clinical diagnosis is correct you will observe growing from the wall of the bladder a delicate structure resembling an oak tree, a villous papilloma (Fig. 1), its delicate branches waving gently in the fluid media proclaiming its innocence, and parting these aside with the beak of your cystoscope you will observe the healthy mucous membrane of the bladder wall with the stem of the growth springing from it.

The treatment indicated for this condition is destruction of the growth by electrical coagulation, by transurethral fulguration as originally introduced by Beer. This can be carried out without causing the patient any appreciable pain, without any risk and, if necessary, without the patient losing a day's work, and a cure can be effected with less risk of recurrence of the disease than by any other form of treatment.

Unfortunately, the laity and even some members of the medical profession have not yet learned the lesson that the occurrence of hæmaturia is an indication for the necessity of an immediate cystoscopic examination, and occasionally a case comes to us where recurrent hæmorrhages have taken place over a lengthened period without the cause of it

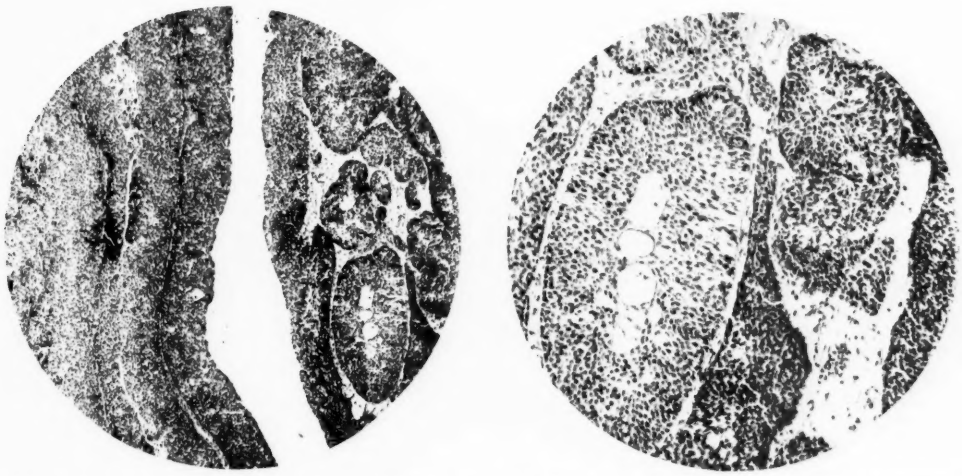


Fig. 4. Low and high power photomicrographs of bladder papilloma, early malignancy, showing in one or two places a definite invasion of the pedicle by the epithelium, accompanied by a change in cell type approaching a squamous metaplasia. The appearances are those of early malignancy.

having been investigated. I have had one case in which a doctor treated a patient for 18 years medically for intermittent hæmaturia due to a tumor of the bladder. The untreated growth increases in size; by implantation, daughter tumors develop on the adjacent bladder wall and not infrequently the nature of the growth alters (Fig. 2) and malignant changes develop, a malignant papilloma results. The diagnosis in such cases is frequently difficult. On cystoscopic examination the urinary cavity may be found to be filled with multiple growths so that a complete examination is almost impossible. If these are bleeding it is still more difficult to obtain a clear view of the interior of the bladder. Certain appearances are suspicious of the onset of malignant changes. Sometimes around the base of a villous papilloma, which in itself looks innocent, the mucous membrane instead of having a normal, healthy look appears granular and congested. Subsequently from this area, the brushwood area as I may call it, daughter tumors are liable to grow. An appearance more characteristic of a malignant papilloma is that in which the growth is observed to be more sessile. Instead of consisting of delicate waving branches, these are fused together (Fig. 3) forming an irregular, crenated surface. When doubt exists as regards the exact nature of the growth it is, of course, possible to remove a portion of it by means of a cystoscopic rongeur for pathological examination. I would not, however, recommend this practice. It necessitates further instrumentation with its attendant discomfort, and the damage done to the tumor causes the escape of its cells into the bladder, and these may become implanted and be the site of daughter growths. The most important reason, however, that leads me to recommend that it be not employed is the fact that the portion of tumor removed will most probably be from the villi projecting into the bladder cavity, and not infrequently on histological examination this will be found to have the structure of an innocent new-growth. If, however, a complete excision of the growth by open operation is carried out, a subsequent pathological examination sometimes reveals signs of early malignant changes at the base of the tumor where it is attached to the bladder wall (Figs. 4 and 5). This report from the pathologist intimating that signs of malignant disease have been discovered is naturally most disappointing, and fear that recurrence of the disease may take place naturally arises. The clinical experience with such cases, how-

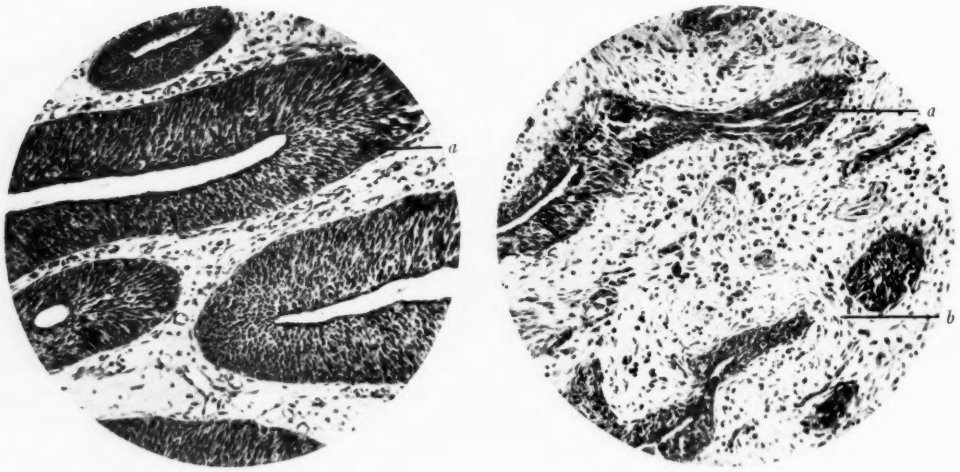


Fig. 5. Recurrent carcinoma of the bladder. Left figure shows transitional epithelial type of cell proliferation and papillomatous character of growth, *a*. In this part the tumor is much less malignant looking than in some other portions having more irregular type of cell growth and more hyperchromatosis. There is vascularization of stroma with young capillaries. The right figure is a deeper portion of the same tumor showing greater irregularity of growth and invasion, *a*. Stroma, *b*, of granulation tissue type with polymorphonuclears, fibroblasts, and young capillaries.

ever, is more encouraging, in that frequently a permanent cure follows the original operation. The treatment I would therefore recommend for the localized sessile papilliform ingrowth into the bladder cavity, whose crenated, fused surface and granular margin appear to indicate that it is an early malignant papilloma, is to remove the growth by the operation of suprapubic cystostomy. If, when the bladder is opened and gentle traction is made upon the growth and its pedicle lifts up with it the loose, adjacent bladder mucosa, an excision of the growth with the adjacent mucous membrane will be found to be sufficient to effect a cure. To avoid the implantation of tumor cells and the subsequent formation of daughter tumors in these cases it is advisable to fill the bladder at the commencement of the operation with a solution of nitrate of silver in the strength of 1:1000, and later to flood the open bladder and wound with the same solution. Such patients should undergo a cystoscopic examination every 3 months for at least 2 years, as occasionally a minute daughter tumor appears, and if so this can be easily destroyed by a single fulguration. Occasionally a case comes under observation at a stage when the bladder is fully distended with multiple sessile papillomatous growths. When the bladder is opened by suprapubic cystostomy, at first sight it would appear as if short of the most radical surgical procedure no benefit could be

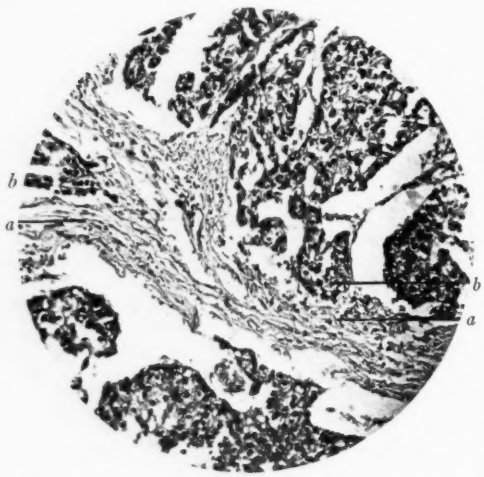


Fig. 6. Carcinoma of the bladder showing invasion of smooth muscle, *a*, by malignant growth, *b*.

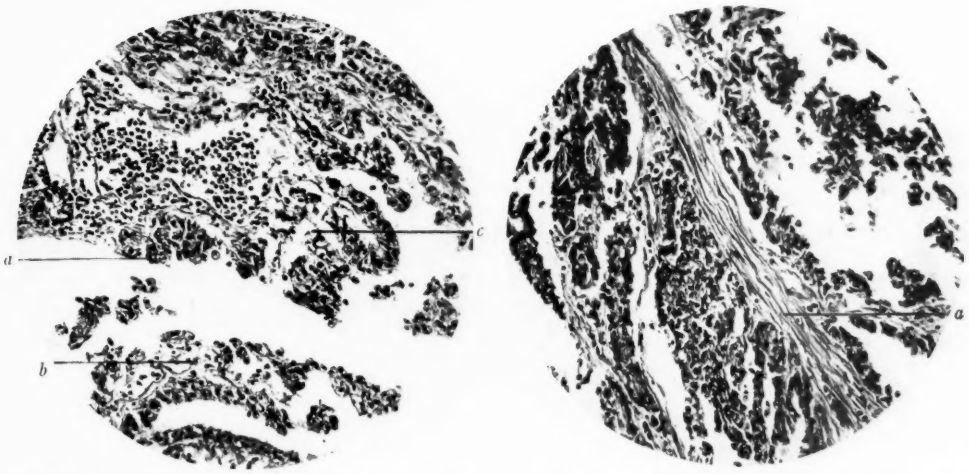


Fig. 7. Carcinoma of the bladder. Left figure shows a papillomatous type, *a*, of carcinoma with vacuolated tumor cells, *b*, and mucinoid degeneration, *c*. Right figure shows an area with less vacuolation of cells. Invasion of the musculature, *a*, of the bladder wall.

effected. My experience with such cases, on the contrary, has been most satisfactory. With them it is safe to conclude that as long as the walls of the bladder are not fixed and indurated the outlook is good. A free and widespread removal of the growth can be carried out by mucous membrane resection. As a result, at the conclusion of the operation the bladder cavity weeps blood from a large part of its surface and hæmostasis is difficult. In a number of these cases I have concluded the operation by packing the open bladder with a large roll of gauze wrung out of nitrate of silver solution and left the wound open and unsutured. In all of them the wound has closed rapidly, and a sound scar with little disfigurement has resulted and an excellent bladder function has been obtained. None of these cases have required a subsequent open operation. In certain of them slight recurrence has taken place but this has been easily dealt with by transurethral fulguration.

When carcinoma (Fig. 6) originates primarily in the bladder and infiltrates its walls a clinical picture is produced which is characteristic. The disease occurs most commonly in males and most usually between the age of 50 and 60 years. Hæmaturia is a constant feature but it is not painless and profuse and intermittent but little in amount and more constant. Increased frequency of micturition is present with occasional spasmodic pain. Cystoscopic examination reveals a bladder with a diminished capacity and with an irregular malignant ulcer with a crater-like surface covered with a gray slough and with margins that are irregular. The process is obviously malignant. If such a malignant ulcer is observed on the summit of the bladder it is important to remember that it is probably due to invasion from without, from a tumor of small or large bowel, ovary, or uterus, which has become adherent to the bladder wall. A barium meal investigation or gynecological examination frequently indicates the cause. If a primary source in any of these organs is revealed, a preliminary laparotomy should be done, the primary growth excised, and subsequently the portion of the bladder invaded taken away. Even when the preliminary examination does not reveal any primary, intra-abdominal source, it is my practice in such cases to open the abdominal cavity first and explore the abdomen, and if nothing is found, to close the peritoneal cavity and then do a partial cystectomy.

When the malignant ulcer is situated on the bladder walls or floor, the extent of the

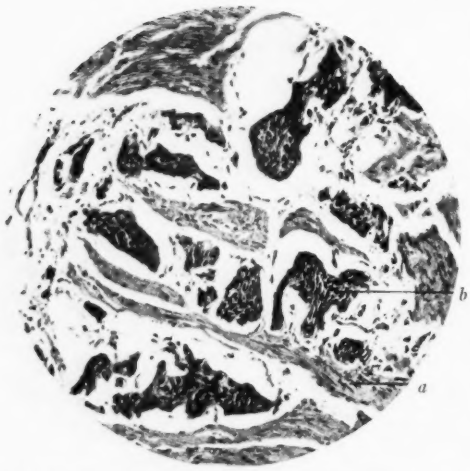


Fig. 8. Carcinoma of the bladder. A transitional cell type of carcinoma. Showing invasion of muscle, *a*, of bladder and transitional stratified epithelium, *b*.

invasion of the neighboring parts cannot be accurately determined until the bladder is opened. If, when this is done, the growth is felt as a stony hard plaque infiltrating all coats of the cavity (Figs. 7, 8, and 9), the limits of the growth should be accurately defined. If one ureteral orifice is involved but the vesical outlet is free, a hemicystectomy, removing one-half of the bladder with a portion of the lower end of one ureter, is the best treatment. At first it was my practice to reimplant the divided ureter into the portion of the bladder that remained. For several years now I have adopted another practice, and I would recommend it to you. The margins of the growth having been defined, the lateral wall of the bladder on that side is mobilized, a portion of bladder amounting sometimes to about half of the wall is removed, cutting wide of the disease (Fig. 10). This mobilized portion now remains attached to the tissues by the ureter. The lower end of the ureter is now divided wide of the disease, and instead of being re-implanted is left *in situ* undisturbed in its cellular tissue bed (Fig. 11). The bladder wall is then reconstructed and the cavity closed, an opening being left above for suprapubic drainage and an opening below in the vicinity of the ureter. A gauze pack is placed extravesically, reaching down to the divided ureter, and the superficial wound is closed (Fig. 12). The gauze pack is removed on the fifth day and the suprapubic drain on the tenth day, and the wound is allowed to close. I have carried out this operation on 11 patients with a satisfactory result, in that in all no suprapubic fistula has remained, the ureter has undergone a process of natural reimplantation, and at subsequent cystoscopic examinations carried out after the injection of indigocarmine a diverticulum has been observed into which the ureter had been reimplanted, and from this diverticulum the blue pigmented urine, coming apparently from a kidney functioning normally, has been seen to be ejaculated.

When on opening the bladder a malignant growth is observed involving the bladder floor in the vicinity of both ureteral orifices, the problem that confronts the surgeon is of momentous importance to the patient. The questions that at once arise are: Is the case to be considered inoperable? Can nothing be done? Is it to be considered as one for treatment by radium or fulguration? Is there any form of palliative treatment which will lengthen the life of the patient and relieve him of his suffering or can radical surgery remove the disease and cure the patient? The inexpedience of the first proposition and the inefficacy of the second have been referred to already. In view of the gravity of radical operative treatment, the mind of the surgeon naturally turns at once to some form of palliative treatment to mitigate the patient's suffering. As has been mentioned already, in certain other parts of the body the harmful effects of malignant disease can be much lessened by palliative treatment. It would appear at first sight that similar benefit would follow the establishment of permanent suprapubic drainage. When the malignant growth in the bladder has involved the vesical outlet and caused obstruction, a certain amount of transient benefit will follow this operation. Where obstruction is not present and the patient suffers from great frequency of micturition and recurring spasmodic attacks of vesical pain, suprapubic drainage does not afford relief, as the attacks of pain are not due to the

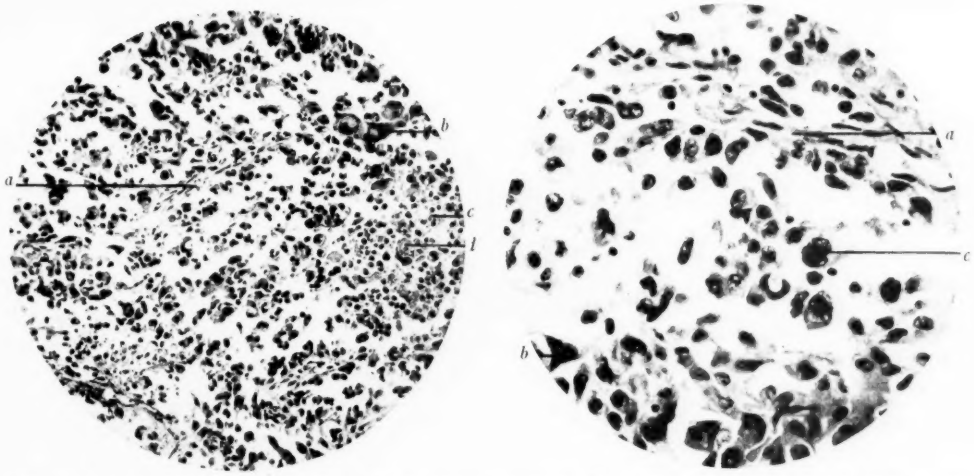


Fig. 9. Carcinoma of the bladder. Figure at left shows remains of fine connective tissue core, *a;* hyperchromatosis; irregular mitosis, *b;* karyorrhexis, *c;* and evidence of necrosis of cells, *d*. The figure at right shows remains of connective tissue core, *a;* irregular mitosis, *b;* and monster cell, *c*.

distention of the cavity with urine but to the infiltration of its walls by the growth. It is the growth and not urine that nature is endeavoring to void when these attacks come on. Similarly the vesical spasms are not relieved when vesical exclusion is carried out and the ureters are implanted on to the loins or into the bowel. Any attempt at partial removal of the growth is to be strongly deprecated on the well recognized principle that partial removal of a malignant growth stimulates increased activity and produces enhanced malignancy in the portion that remains. Finally, therefore, the proposition arises, can radical operative surgery remove the disease and cure the patient, is the operation of total cystectomy possible, and if so, is it ever warranted?

I have performed the operation of total cystectomy on only 8 cases. My experience is thus limited. It is, however, sufficient for me to say that the danger to life attending it is not a contra-indication to its performance. All the 8 cases recovered successfully from the operation. I can also claim that the comfort of the patients was greatly enhanced by the treatment, in that they were relieved of the intolerable misery of the recurring vesical spasms, natural sleep was possible, and life was tolerable. I cannot claim that the majority were permanently cured. All lived for over a year and a half after the operation, 2 are still alive that we operated on 4 and 3 years ago, respectively, 3 have died from recurrence of the disease, and 2 of these I visited shortly prior to their end and found that recurrence had taken place in the pelvis where a secondary carcinomatous mass, like an encephaloid cancer in a woman's breast, had appeared; the swelling was, however, painless and although associated with some œdema of the lower extremities was producing no discomfort. Their peaceful end convinced me that if we had accomplished no more, the operation had been justified. That the disease should have recurred in these cases was not a contra-indication to operation but an indication that it should have been carried out earlier. My limited experience has also convinced me that total cystectomy is an operation capable of great improvement. Up to the present it has been carried out as a desperate remedy for a desperate situation. The disease has been advanced and the patient profoundly debilitated by it. It has necessitated also 3, and in several cases 4, operations. I am convinced that if it be accepted that a complete cure of malignant disease of the urinary bladder cannot be

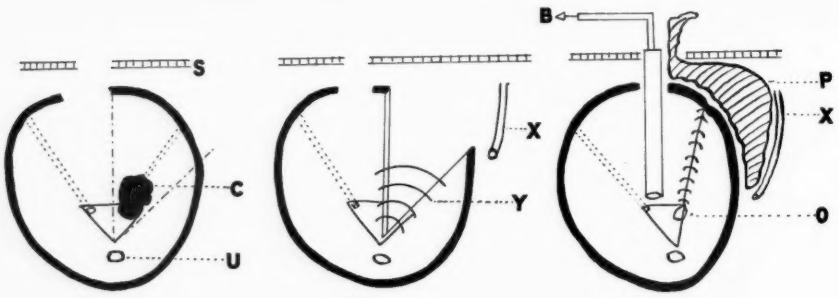


Fig. 10. Fig. 11. Fig. 12.

Fig. 10. Hemicystectomy for carcinoma of bladder involving lower end of right ureter showing portion of bladder wall excised.

Fig. 11. Hemicystectomy for carcinoma of bladder involving lower end of right ureter showing portion of bladder wall removed, ureter divided, and left undisturbed in its cellular tissue bed.

Fig. 12. Hemicystectomy for carcinoma of bladder involving lower end of right ureter showing reconstruction of bladder with an opening left for suprapubic drainage and an opening below in the vicinity of the divided ureter.

effected by any method of cell destruction and that total cystectomy offers a prospect of effecting such a complete cure, the steps of the operation will be able to be shortened, the disability attending the removal of the bladder very materially mitigated, and a treatment evolved which should reach a standard of perfection such as has been obtained in carcinoma of the rectum, where a cure can be effected at the price of a permanent inguinal colostomy.

Before undertaking the operation of total cystectomy, certain problems have to be decided. When is it indicated? Up to the present I have never felt warranted in undertaking it without having first opened the bladder, examined the growth, defined its extent, and decided that less radical procedure would not suffice. Time is thus lost and another operation added to the patient's trials. If this could be dispensed with, and by clinical and cystoscopic examination sufficient data obtained, the treatment would be simplified. The next problem is, how best to arrange for the deviation of the urine stream after the bladder has been removed. The ideal course naturally would be to transplant the ureter into the bowel. I have done this in 2 cases as part of the operation of total cystectomy, and both were successful (Fig. 13). It has, however, the disadvantage of having to be carried out in two stages, first the right and then the left ureter being transplanted into the pelvic colon, the fear being that if both were done at one time fatal anuria might supervene. I see no reason why ultimately a bilateral ureteral transplantation should not be possible, particularly in view of the knowledge we have gained from Coffey's work in this department of surgery, carried out especially in treating congenital vesical exstrophy. His work may be briefly described as an anatomical observation on which a physiological principle was based, the accuracy of which was established by experimental research and confirmed by clinical work in the operating theater. It is this: when nature lays down an excretory duct into another channel or cavity, where the latter is subject to a varying degree of pressure from within, and where in consequence regurgitation into the duct might be liable to occur, nature prevents this by providing the duct with a mucous valve by carrying it for a short distance beneath the mucous membrane before it opens into the channel. The opening of the common bile duct into the duodenum and of the ureters into the bladder illustrate this arrangement. If, experimentally, the same course is followed and the implanted duct is carried for a short distance between the muscular coat of the bowel and the mucous membrane, a similar valve is formed and regurgitation into the duct and

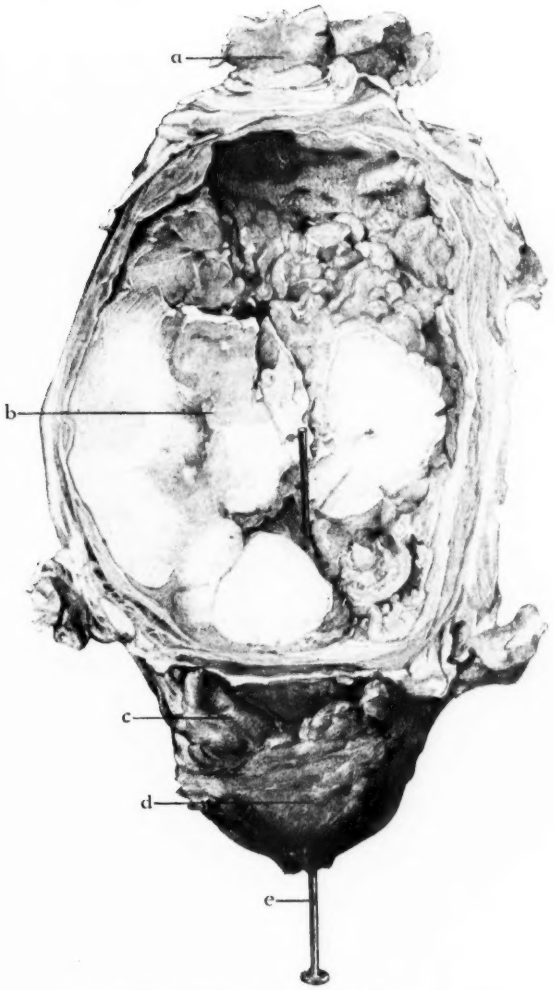


Fig. 19. Total cystectomy and prostatectomy for carcinoma of the urinary bladder, showing bladder, prostate, and seminal vesicles removed in one piece. *a*, Healed scar of original exploratory abdominal incision; *b*, carcinoma of urinary bladder; *c*, seminal vesicles; *d*, prostate; *e*, glass rod in urethra.

Treatment of Malignant Tumors of the Urinary Bladder. —*Henry Wade.*

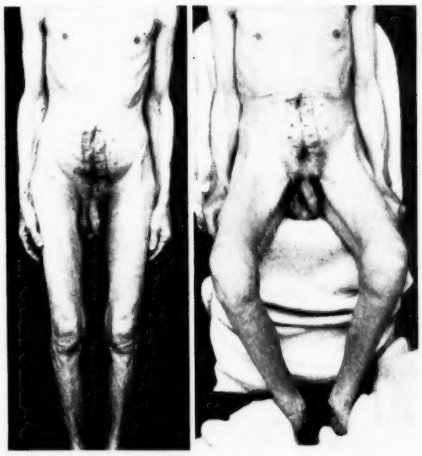


Fig. 13.

Fig. 14.

Fig. 15.

Fig. 13. Patient upon whom had been performed total cystectomy for carcinoma of the bladder showing healed lateral incisions through which the ureters were transplanted into the pelvic colon and the midline incision through which the bladder was excised.

Fig. 14. Total cystectomy performed after the ureters had been transplanted into the lateral aspect of the abdominal wall.

Fig. 15. Total cystectomy after the ureters had been transplanted on to the lateral aspect of the abdominal wall showing healed scar of cystectomy wound and ureteral catheters introduced to demonstrate ureteral orifices.

dilatation of it does not occur subsequently. On the other hand, if the duct is implanted direct, it dilates from regurgitation and backward pressure, and an ascending infection is liable to follow. For several years now I have employed the Coffey-Mayo technique in all operations of vesical exclusion carried out for vesical exstrophy, severe vesicovaginal fistula, and in the 2 cases of total cystectomy already mentioned. In all of these cases the ureteral transplantation has been done in two stages but in all of them a most careful record has been kept of the urine voided per rectum after the first ureter was implanted into the colon, and in every case urine was voided per rectum on the evening of the operation and continued to be passed daily thereafter, demonstrating that anuria from œdema at the site of implantation does not occur with this technique. This observation has suggested to me that with it a bilateral transplantation in one stage might be successfully carried out. The modification that Charles Mayo added to the Coffey technique does not at first sight appear much. It consists of nothing more than arranging how the ends of a catgut suture are allowed to hang, the stitch used to draw the divided ureter into the lumen of the bowel instead of being cut short has its free end passed up the lumen of the ureter and thereby forms a wick down which the urine travels through the area of postoperative œdema into the bowel.

It is obvious that the patient's comfort after total cystectomy will be much greater if the urine stream flows into the bowel than onto the surface of the loins. Unfortunately, the debilitated state of the patient may contra-indicate the former proceedings, and thus the latter is preferable. In 6 of my cases the ureters were transplanted onto the lateral aspect of the abdominal wall (Figs. 14, 15, and 16), a simple, safe and speedy procedure which can be carried out in one stage. The ureters were exposed through a gridiron incision, divided and brought to the surface and anastomosed to the skin. Several attempts were made to create by a plastic operation a nipple at the orifice to facilitate the collection of urine but all these attempts failed, with the result that the collection of urine from the two ureteral fistulæ was rendered more difficult. After several attempts we devised the apparatus that is illustrated (Figs. 17 and 18).

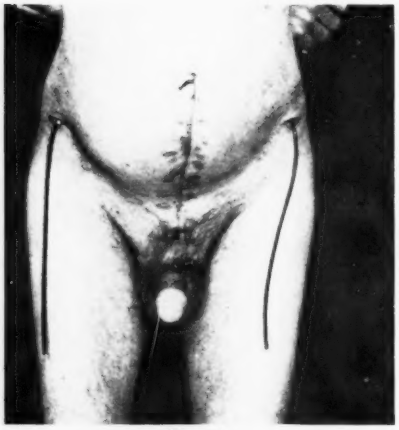


Fig. 16.

Fig. 16. Total cystectomy and prostatectomy for carcinoma of the bladder. Catheters are seen passing into implanted ureters.

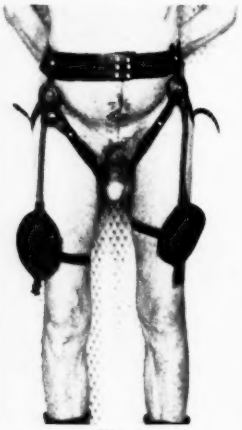


Fig. 17.

Fig. 17. Apparatus worn for collection of urine.

Fig. 18.

Fig. 18. Another type of apparatus worn for collection of urine.

It consists of two rubber cots that fit accurately over the ureteral orifices. These collect the urine, which is carried down from them into the urinals fixed to the thighs. The apparatus has only been moderately successful, in that it has been found extremely difficult to devise an instrument which will keep in accurate apposition when the patient is standing, sitting, or lying down. I am convinced, however, that this problem should not prove insoluble. The final operation in which the entire bladder is removed is undertaken about 3 weeks after the ureters have been transplanted. If prior to it, the bladder which was opened has closed, the operation will be rendered safer and easier. The procedure is as follows: The bladder is filled to its maximum capacity with a solution of nitrate of silver in the strength of 1:1000. The peritoneal cavity is then opened through a midline, suprapubic incision which is carried down to the symphysis pubis, the extraperitoneal portion of the anterior surface of the bladder being freely exposed. The healed scar and cicatricial tissue of the previous cystostomy operation are left attached to the anterior surface of the unopened bladder. The peritoneum is dissected off the posterior aspect of the bladder, the obliterated hypogastric arteries, and urachus being divided. The bladder is now further mobilized by blunt dissection, the hand being swept round its lateral and posterior surfaces to separate it from the loose areolar tissue to which it is attached—a procedure which is easy if the bladder is firmly distended. The superior vesical arteries are isolated, ligatured, and divided. The vas deferens on each side is now defined, isolated, and divided. The ureters have already been severed close to the bladder at the previous operation. The partially isolated bladder is now pressed firmly backward and the strong vascular cord in front, the puboprostatic ligament, defined, clamped with strong hæmostatic forceps, and divided. The anterior surface of the prostate is brought into view and cleared down to the apex of the gland. In a similar manner the lateral and posterior aspects of the prostate are freed. In doing so the seminal vesicles are isolated and carried forward along with the bladder and prostate to which they are adherent. The prostate is drawn out of the muscular hammock in which it is slung, this hammock being formed by the levator ani muscles on either side and recto-urethralis muscle below. The prostatic urethra is finally divided, cauterized and ligatured, and the bladder, prostate and seminal vesicles removed in one piece (Fig. 19). The divided

pelvic peritoneum is reunited and the peritoneal cavity closed, a gauze tampon being loosely packed into the place from which the bladder was removed. The wound in the abdominal wall is now sutured with the tampon drain emerging at its lower end. When the patient has recovered from the shock of the operation, the most noticeable improvement observed is the freedom he has from the recurring spasmodic painful contractions to which he previously was a martyr.

In the advanced case of malignant disease of the bladder where the state of the patient and the extent of the disease contra-indicate any attempt at a complete removal by total cystectomy, it appears to me that the patient's suffering could be materially mitigated by an operation upon the sympathetic nerves to enervate that organ. The success that has attended similar operations in the hands of Leriche, Learmonth, Hunter, and others warrants this assumption. I have not yet had a case suitable for this form of treatment, but I am convinced that it is a field of surgery that will merit being explored.

The operation of total cystectomy for carcinoma of the bladder, in my opinion, has a definite place in surgery, and in the light of our present knowledge circumstances arise where its performance is warranted. I look forward to the day when from discoveries yet to be made the treatment of this dire disease will be successfully achieved by simpler remedies. Until that time I think we are warranted in seeing whether we cannot simplify and improve the treatment I have recommended and make it safer and thus justified, when the disease is in its earlier manifestations and the prospects of a successful cure consequently greater.

DIVERTICULA OF THE URINARY BLADDER[1]

WILLIAM E. LOWER, M.D., F.A.C.S., CLEVELAND, OHIO
Cleveland Clinic

DIVERTICULA of various hollow organs of the body are frequently encountered. They may be present without causing any outstanding symptoms, but that they do often cause symptoms and impairment of health is well attested by the many reports which have appeared in the literature of diverticula of the gastro-intestinal tract. In many cases, however, their presence is not suspected and the symptoms produced by them are supposed to be due to some other condition for which treatment is instituted. This is true also of diverticula of the urinary bladder.

The most common location of diverticula in the urinary bladder is in the lateral wall near the ureters. It is interesting to note that in the cases cited in the literature, as in our series, more were proximal to the left than to the right ureter—a fact, however, that seems to have no especial significance. In 62.1 per cent of our cases the diverticulum was in the lateral wall. In 21.2 per cent it was on the posterior wall; rarely in the dome and still less frequently in the trigone.

Diverticula may be single or multiple. In our series a single diverticulum was present in 63 per cent, two diverticula were demonstrated in 14.9 per cent, and there were more than two in 22 per cent.

The causative factors of diverticula of the gastro-intestinal and of the urinary tract are probably fundamentally identical. They are no doubt due to some congenital defect which, becoming aggravated under certain conditions, produces a diverticulum.

In the light of E. M. Watson's observations it seems probable that there is a congenital predisposition to their formation, but that their clinical recognition during adult life is hastened and "their dimensions greatly increased by any of the factors that would bring about increased vesical distention or increased activity of the bladder musculature." This opinion is strengthened by the fact that diverticula nearly always occur in males in whom also the urinary outlet is more frequently obstructed.

In our own series of 151 cases (see previous report of 110 cases) only 2 were in women. That obstruction to the urinary outlet is a strong etiological factor is further suggested by the fact that in 48.4 per cent of our total series, some obstruction of the urinary outlet existed, a ureteral caruncle being present in each of the 2 women in the series.

Whatever their cause—whether they be congenital or acquired—there is little we can do to prevent their formation, and our attention must therefore be devoted to diagnosis and treatment.

AGE INCIDENCE

Diverticula may occur at any age but they usually occur after the age of 50 years, this being true in 81.3 per cent of our cases. Our experience accords with the findings of many other reporters such as Judd, Hinman, Legueu and Papin, and others. The age incidence in our total series is given in Table I.

TABLE I.—AGE INCIDENCE

Years	Cases
20–29	3
30–39	7
40–49	16
50–59	28
60–69	48
70–79	38
80 plus	2
Not stated	1

SYMPTOMATOLOGY

Diverticula present no specific symptoms. Their presence should be suspected, however, in any case in which frequency, difficulty in urination, and pyuria are present and in particular whenever there is persistent pyuria after repeated irrigations. The best diagnostic method is a roentgenographic examination of the bladder which should include an anteroposterior plate and at least two plates taken from different angles. If two or more urinations are necessary to empty the bladder, the

[1]Presented before the Clinical Congress of the American College of Surgeons, Philadelphia, October 13–17, 1930.

presence of a diverticulum should always be suspected especially if the first urine voided is comparatively clear and is followed by the voiding of thick, foul-smelling urine and if difficulty in completely emptying the bladder is lessened by changing the position of the patient.

In our series, the order of frequency of the different symptoms in uncomplicated cases —that is, cases in which no other pathological condition of the genito-urinary tract was demonstrated—is shown in Table II.

TABLE II.—SYMPTOMS

Symptom	Per cent
Frequency	51.5
Retention	36.3
Pain on urination	27.3
Hæmaturia	24.2
Cloudy urine	21.2
Difficulty in urination	15.1
Pyuria	12.1
Acute pain	12.1
Dribbling	9.0
Burning	6.0
Incontinence	3.0

In the presence of inflammation, burning upon urination and dysuria may be quite pronounced. Hæmaturia, pyuria, and other urinary irregularities except those noted above, when present are generally due to some complicating condition.

DIAGNOSIS

Before the advent of the roentgenogram, we had little to guide us in the diagnosis of diverticula in the gastro-intestinal tract, and although the cystoscope was a great aid in determining the presence of a diverticulum of the urinary bladder, there was no way by which its size and contents could be accurately determined.

This accounts for the paucity of reports of diverticula until within comparatively recent years, for, after the existence of such a condition was suspected, the profession did not have at hand the means whereby to diagnose it properly.

Indeed, the cystoscope and roentgenogram are essential in making an absolute diagnosis of the presence of a diverticulum for the reason, as stated above, that there are no classical symptoms which may be considered as pathognomonic of the presence of this condition. Many diverticula are now found in the course of a routine cystoscopic examination in cases in which their presence has not been suspected, especially in cases of hypertrophy of the prostate.

Fig. 1. Cystogram showing a vesical diverticulum on the posterior surface of the bladder. Stones are seen in both bladder and diverticulum.

Frequently the clinical history leads to a suspicion that a diverticulum is present. This is especially true in the case of men over 45 years of age who complain of difficulty in urination, frequency, pyuria, and have a feeling that the bladder is incompletely emptied. If two successive urinations are necessary to empty the bladder and there is no prostatic difficulty, the presence of a diverticulum is suggested.

Although a cystoscopic examination, when skillfully made, will usually reveal the presence and the situation of a diverticulum, its size cannot be accurately estimated. The size of the opening into the diverticulum is no index to the size of the sac, as the largest diverticula often have very small openings. We feel, therefore, that after the presence of a diverticulum has been determined, the wisest procedure is to determine its size by cystograms. After the bladder has been drained by catheterization, it is refilled with a solution of sodium iodide, and a picture is taken with the patient on his back. Then the patient is turned on the side and another roentgenogram is taken. The bladder is then emptied as completely as possible by catheterization without

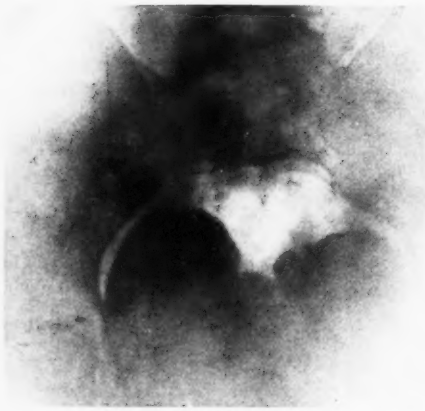
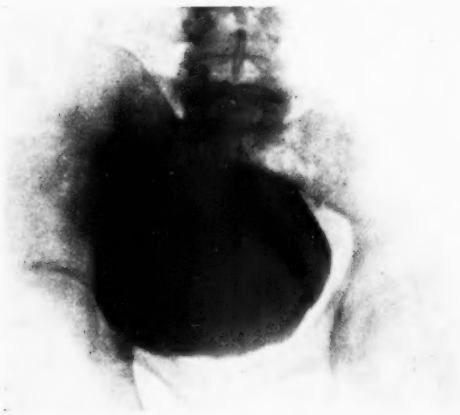


Fig. 2. Left, Cystogram of bladder showing two large vesical diverticula, one on either side of the bladder.



Cystogram showing outline of bladder after removal of diverticula.

introducing the tip of the catheter into any of the diverticula, and another picture is taken. The roentgenogram is then studied to determine whether or not retention is present.

This method of studying the bladder for the determination of the presence of diverticula is much more satisfactory than the older method of filling the bladder and making films in the usual positions, as when the films thus made were examined it was frequently found that the diverticulum was not satisfactorily demonstrated.

The final film, made after the bladder has been emptied, is sometimes of considerable importance because it may indicate whether or not a diverticulum should be removed.

COMPLICATING CONDITIONS

We have already referred to common complicating conditions which may either mask the presence of a diverticulum or lead to its discovery. Aside from prostatic conditions the most common complications are vesical infection, vesical calculi, and vesical tumors.

Many cases of calculi associated with diverticula have been reported; they may be in the bladder, in the diverticulum, or in both, or a "dumb-bell" stone may lie partly in the bladder and partly in the diverticulum. In a series of 133 cases reported from the Mayo Clinic, the following incidence of stones was noted:

	Cases
Stone in bladder and none in diverticulum	13
Stone in bladder and also in diverticulum	9
Stone in diverticulum	6

In our series, the incidence was as follows:

	Cases
Single stone in diverticulum	3
Multiple stones in diverticulum	8
Stones in bladder alone	9
Stones in bladder and diverticulum	7

Stagnation and infection are naturally instrumental in the formation of calculi, and these factors are usually present in varying degrees in these cases. As shown by our statistics, calculi in the diverticulum may be single or multiple. If they are multiple they may become faceted and lie close together, so that only a roentgenogram will show that more than one stone is present. When large calculi are found in the diverticulum, they are usually associated with calculi in the bladder.

The presence of a malignant growth is a not altogether rare complication of diverticulum of the bladder. In our series we have had 5 cases in which a diverticulum was associated with a tumor of the bladder, and in 2 of these cases, a papilloma was present in the diverticulum itself.

Infection of a diverticulum is of frequent occurrence and varies in intensity from a catarrhal inflammation to an actual ulcerated condition. Inflammation of the diverticulum is usually associated with cystitis, which gives

Fig. 3. Cystogram showing a dumb-bell stone, part of which is in the bladder and part in a diverticulum.

the usual symptoms. Cases have been seen in which infection has progressed to such an extent that rupture of the diverticulum has occurred. The infection is more marked in those cases in which the orifice of the diverticulum is so small that it empties incompletely and stagnation results, the contents of the diverticulum finally becoming purulent. Efforts at emptying the bladder will often close the opening into the diverticulum like a sphincter muscle and instead of the contents of the diverticulum flowing out it will be retained. When the effort is over the opening relaxes and the contents empty into the bladder. Therefore, a second voiding is necessary to empty the bladder.

TREATMENT

The following surgical procedures for the treatment of diverticula of the bladder have been reported: (1) suture of the orifice of the diverticulum without excision of the sac (Pousson); (2) enlargement of the orifice (Pousson and Chute); (3) radical excision of the diverticulum *in toto* (Young, Hinman, Howard, Lower, Squier, and others).

Surgeons who have had the widest experience in the treatment of diverticula seem to be agreed that complete excision is the only procedure which leads to permanently satisfactory results. Moreover, there is a unanimity of opinion that, since obstruction in some form is nearly always an important

Fig. 4. Cystogram showing extensive multiple diverticulosis of the bladder.

factor in the development of a diverticulum of sufficient size to be brought to clinical notice, the cause of such obstruction should be removed with the diverticulum, if recurrence of the malady is to be avoided.

In our clinic the following operative technique has been adopted: Under spinal or

Fig. 5. Photograph of diverticulum involving the left ureter. In removing this diverticulum it was necessary to transplant the ureter into the bladder wall.

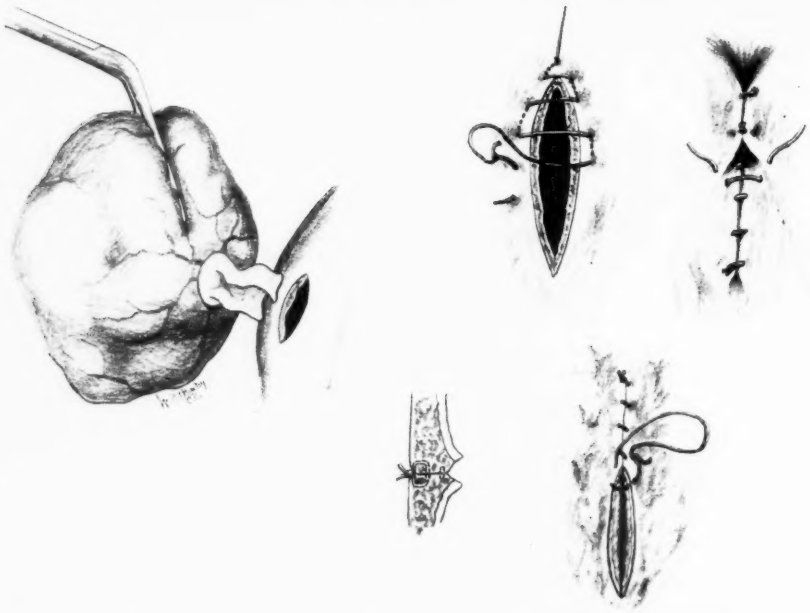


Fig. 6. Technique of closing the bladder wall after removal of a diverticulum.

sacral anæsthesia, to which analgesia with nitrous oxide-oxygen is added in the case of an apprehensive patient, a suprapubic incision is made and carried down to the bladder. After the peritoneum has been stripped back, the bladder is opened. Exposure of the interior of the bladder is secured by means of flexible retractors and a Cameron light. The diverticulum is located and from its size and position the mode of procedure is determined.

If the extravesical approach is to be used, the collapsed diverticulum is first converted into a solid or semisolid tumor by packing it with a gauze tape. It then becomes a comparatively simple matter to dissect down outside the bladder, lift out the created tumor, sever the attachment of the diverticulum, and close the opening into the bladder. It is important that at the point where the diverticulum has been removed, the bladder be closed with a good muscular apposition, the walls being inverted if possible so as to leave a slight ridge on the inner surface of the bladder rather than a depression at the point from which the attachment of the diverticulum was removed, for such a depression might serve as a starting point for a recurrence of the diverticulum.

One or more small diverticula may be present near a larger one. These are usually left intact, for if the cause of the urinary obstruction is removed and the large diverticulum is excised, the small ones apparently do not increase in size or cause symptoms.

The prevesical space should always be carefully drained. The bladder is closed with catgut sutures, a suture being applied first, to bring the two cut surfaces into apposition, and then an interlocking suture which passes entirely through the muscular coat. An indwelling catheter is placed in the urethra and is allowed to remain for several days.

For the removal of a diverticulum in which the ureter is involved, various methods have been employed. Often the ureter will appear to empty into the diverticulum when in reality it has only been pulled over its edge, as it were, and the diverticulum can be removed without materially disturbing the ureter. When the ureter is included in the

diverticulum or injured in the removal it must be carefully transplanted into the bladder. The transplantation should be done in such a way as to retain its physiological function as nearly as possible. A ureter has been transplanted in each of 10 of our cases.

MORTALITY AND END-RESULTS

In the reported cases the operative mortality varies from 6 to 8 per cent. In our series of cases in which excision of the diverticulum was performed the operative mortality was slightly over 5 per cent. In a few of the earlier cases, there has been a recurrence and a second operation done. However, in the later group an improved technique has prevented recurrences and the patients have been relieved of the principal symptoms of which they had complained. Postoperative cystograms have been made in many of these cases and no evidences of diverticula have been noted. The most difficult thing to eliminate entirely is the presence of some pus in the urine, especially when the infection has been of long standing before operation.

PROGNOSIS

If a radical operation is performed early and before renal impairment has become marked, the prognosis is usually favorable, although, of course, the prognosis depends upon any complicating condition which may be present. If, for example, a malignant growth is present, the prognosis must be guarded.

Whether or not there will be a recurrence of the diverticulum depends in part upon the manner in which the opening into the bladder is closed after the diverticulum is removed—if the musculature is not well approximated, or if any defect is left, it may be the starting point for a recurrence; and in part, upon whether or not the obstruction to the urinary outflow is removed.

In every case the relief secured from a radical operation is so much greater than that secured from palliative measures that there can be no doubt that the radical operation is the method of choice.

REFERENCES

1. Cabot, Hugh. Modern Urology, Diseases of Bladder, Ureter and Bladder, Ureter and Kidney. Vol. ii, 2d ed., p. 65. Philadelphia: Lea & Febiger, 1924.
2. Hinman, F. Vesical diverticulum. Surg., Gynec. & Obst., 1919, xxix, 150–172.
3. Howard, H. W. Quoted by Cabot, loc. cit., p. 65.
4. Judd, E. S. Diverticula of the bladder. Ann. Surg., 1918, lxviii, 298–305.
5. Legueu and Papin. Diverticules de la vessie. Arch. urol. de la Clin. de Necker, 1921, p. 2.
6. Lower, W. E. An improved method of removing a diverticulum of the urinary bladder. Cleveland M. J., 1914, xiii, 1–7.
7. Lower, W. E., and Higgins, C. C. Diverticula of the urinary bladder with report of 110 cases. J. Urol., 1928, xxii, 635–661.
8. Pousson. Quoted by Cabot, Hugh, loc. cit., p. 65.
9. Pousson and Chute. Quoted by Cabot, Hugh, loc. cit., p. 65.
10. Squier, J. B. Surgery of the hourglass bladder. New York M. J., 1914, xcix, 1026–1028.
11. Watson, E. M. Developmental basis for vesical diverticula. J. Am. M. Ass., 1920, lxxv, 1473.
12. Young, H. H. The operative treatment of vesical diverticula with a report of four cases. Johns Hopkins Hosp. Rep., 1906, xiii, 401–446.

STERILITY IN THE MALE[1]

FRANCIS R. HAGNER, M.D., F.A.C.S., WASHINGTON
Professor of Genito-Urinary Surgery, George Washington University, Attending Genito-Urinary Surgeon, Garfield Memorial Hospital

IN this paper I wish to present the subject of sterility in the male mainly from the standpoint of operative correction. It may not, however, be amiss, by way of introduction, to review the various causes of male sterility.

Though childless wedlock is due, in the great majority of cases, to the female, the share of the other partner in the union should also claim attention. Reliable statistics show that the male is at fault in about 1 case in 6, or even more. Grosse found the male deficient in 18 per cent in a series of 192 cases. Forty-five per cent of the soldiers in the German Army who had had bilateral gonorrhœal epididymitis were found to be sterile. Noeggeroth found 8 sterile marriages in a series of 14 to be due to the male.

It is, therefore, quite essential to examine carefully into the procreative ability of the male. It has usually been the rule to consider the man sexually normal if his genitals were well developed, if he could copulate in a normal manner, and if he had what seemed to be normal ejaculations of semen. With the advance of genito-urinary surgery, however, the condition of the semen and the integrity of the seminal tract have been more carefully studied, and important facts have been brought to light.

In the first place, sterility may be due to aspermia, or failure of elaboration of the semen. For this condition, depending as it does on developmental defects, there is, of course, no remedy.

Second, sterility may be due to azoospermia, an absence of spermatozoa in the semen.

Third, the cause may be oligospermia—the spermatozoa, though present in the semen, being few in number, motionless, or having only transient movement.

Fourth, anatomical abnormalities may be present which prevent the passage of semen through the urethra, or which (as in the case of hypospadias and fistula) allow the escape of the semen outside the normal channel.

Fifth, the presence of a stricture in the urethra may prevent the escape of the semen from the meatus.

Finally, in those cases in which no specific cause can be found in either sex, we are forced to consider the theory of sexual incompatibility, or an apparent lack of affinity of one cell for another, as demonstrated in the experience of a childless first marriage followed by later fertile marriages on the part of both members. Breeders note this phenomenon in the mating of stallions and mares.

There may be inability to copulate even when the sexual organs are well developed. In these cases the subject has usually been the victim of some psychical disturbance. The prolonged and frequent overstimulation of the secreting structure of the testicle finally results in exhaustion of the gland, with production of imperfectly formed spermatozoa, even though the quantity and quality of the fluid may be normal. Such cases may be cured if the patients can be made to lead a hygienic sexual life.

Men with double undescended testicles are almost invariably sterile. Many authorities believe that in these cases sterility occurs shortly after puberty. This belief may be an argument in favor of operating on double undescended testicles before puberty in order to prevent this complication. We have had several of such patients whom we operated upon before puberty with the result that the patients later secreted spermatozoa and impregnated their wives. Men who have received serious injury to the secreting structures of the testicles may also be sterile. My impression is that all cases of bilateral retention of the testicle in the abdomen are sterile and that many are almost asexual.

Bilateral tuberculosis of the epididymis frequently causes sterility through destruction of the epididymis or the testicle. Here there is no hope of cure. But in bilateral gumma of the testicle, which also causes sterility, cure may follow specific treatment. One of my

[1] Presented before the Clinical Congress of the American College of Surgeons, Philadelphia, October 13-17, 1930.

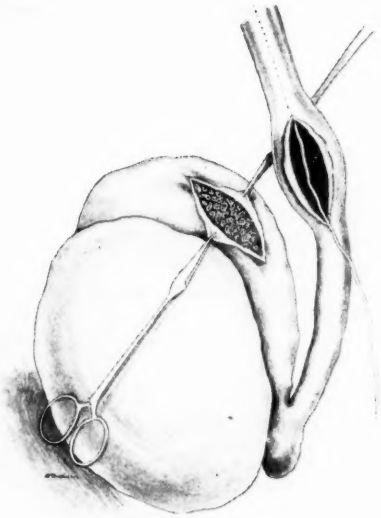


Fig. 1. The vas opened and silkworm gut passed up lumen. Incision into globus major and tubules cut across.

Fig. 2. The placing of the fine silver wire sutures to complete the anastomosis.

cases had bilateral gumma making a mass almost as large as a man's head. On examination after intensive treatment, the testicles appeared normal. This patient afterward secreted normal spermatozoa and has since been the father of seven children.

Another cause of sterility is the X-ray. Workers in X-ray laboratories, however, usually recover after they have withdrawn from exposure to the rays.

When inflammation has attacked the greater portion of the prostate so as to block up the ejaculatory ducts, after an orgasm, there may escape two or three viscid drops that contain principally pus cells and degenerated prostatic cells, but no spermatozoa. In other cases there may be so much pus present as to cause the spermatozoa to die when they come in contact with the fluid. Such a condition is diagnosed by a microscopical examination revealing pus and dead spermatozoa in the fluid obtained by massage of the prostate and seminal vesicles, or better, by that normally ejaculated. I have seen several patients cured of sterility of this character by appropriate treatment of the prostatic condition.

Atrophy of the testicles following bilateral orchitis, or epididymo-orchitis in mumps, is not infrequently a cause of sterility. This differs materially from gonorrhœal infections of the gland, as it is a true orchitis.

Of all the causes of sterility, however, as shown by numerous statistical studies, the principal one is bilateral gonorrhœal epididymitis. Orchitis itself probably never occurs in gonorrhœal infections. I say this from our experience in the operative treatment of gonorrhœal epididymitis, as in more than 300 cases we have never found evidence of involvement of the testicle itself—the epididymis and tunica vaginalis seeming to bear the brunt of this infection.

Traumatic epididymitis rarely leads to sterility. In bilateral gonorrhœal epididymitis the healing process leads to the formation of scar tissue which causes an occlusion of the efferent ducts of the epididymis, and this prevents the egress of the normal spermatozoa, which are formed by the unaffected testes. The globus minor is the portion of the epididymis most involved, and it is in this very portion that occlusion has the most dangerous results, as there is here but one efferent duct; while in the globus major the

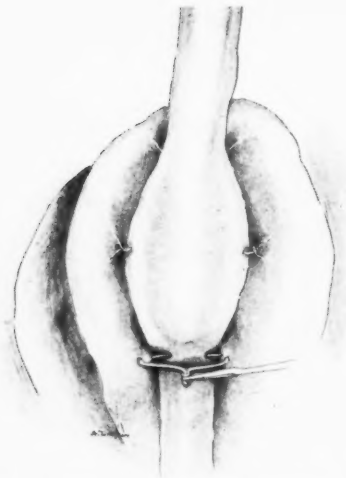


Fig. 3. The anastomosis completed. The silver wire sutures drawn up and twisted.

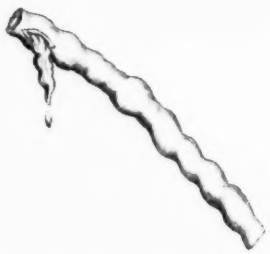


Fig. 4. The beading of the cord which is often present where the lumen is occluded. On incision a thick yellow material escapes.

efferent ducts are numerous, and the obstruction of one or two would still leave open other channels.

It was because of the known patulency of the globus major following gonorrhœal epididymitis, when the globus minor and the vas deferens in this region became occluded, that the anastomosis of the vas deferens and the globus major was made by Dr. Edward Martin, of Philadelphia, who was the pioneer in this field. The endeavor to overcome the occlusion by such an operation offers the only chance of recovery.

It is my purpose to speak more at length concerning our successes and failures in the carrying out of this procedure. We open the tunica vaginalis and expose the entire epididymis, as from this approach we are better able to pick out the portion of the globus major richest in tubules, thereby facilitating the discovery of the portion that may contain live spermatozoa. On opening the vas we used to inject argyrol, noting its appearance in the urine, to be sure that the vas was patulous.

We have, however, discontinued this technique, as we have felt that it is important to keep all foreign substances that might tend to cause cicatrization away from the field of operation. We now use the finest tear-duct probe to be sure we are in the lumen, following this with a smooth strand of silkworm gut, which can, in the unobstructed vas, be passed from 16 to 20 centimeters. If, on rectal palpation, there is no evidence of infiltration of the ampulla of the vas, we can be reasonably sure that the vas is patulous. If it is obstructed beyond this point there is no hope of an operative cure. After this examination has been made we select a likely looking place in the epididymis, cutting out an elliptical piece.

If live spermatozoa are present, a milky fluid is usually obtained as soon as the section is removed. The fluid is at once examined on a warm slide, the presence and motility of the spermatozoa being noted. If no spermatozoa are found, this incision is closed with a catgut suture. Another place is selected, and the same procedure is followed. It used to be thought that the spermatozoa were not motile until they came in contact with the prostatic secretion. This belief, however, has been disproved, as they are now known to be actively motile in the epididymis even when occlusion has been present for many years. The testicle is the only gland that does not atrophy when the efferent duct is occluded. This is so important a gland to the well-being of the individual that nature has surrounded it with every protection.

We have tried several types of suture—very fine silk, catgut, and very fine silver wire. Our only successful operations are those in which we have used the silver wire. I cannot explain this fact unless on the theory that

there is less tissue reaction with the silver wire than with the other sutures.

Nearly all of our operations have been done by lateral anastomosis except a few rather atypical ones to be mentioned later. Sometimes we find occlusion of the vas at the first incision, and by going further up the vas we are able to get above this obstruction. Unless great care is exercised to cut only into the lumen of the vas, which is recognizable by the yellowish tinge of its lining, there is a likelihood of the operator carrying the incision through the entire diameter of the tube. It is important not to strip the vas deferens too close.

We place the first suture at the distal end of the incision in the vas, taking a good heavy bite, as this is the anchoring suture for the operation and the obstruction is below this point. The suture is then anchored firmly in the lower end of the elliptical incision of the epididymis. Two lateral sutures are then placed to take a fairly heavy bite in the epididymis and include some of the cut tubules. If only the fibrous covering of the epididymis is taken up in the suture the cut tubules drop back when the anastomosis is made. The suture is then passed through the cut edges of the vas, taking just enough tissue to approximate the edges. The last suture is then passed in the same way through the upper end of the incision in the epididymis. It is then passed through the vas, at the upper angle of the incision, being carefully placed so as not to occlude the lumen. We test this out with a tear-duct probe. The anastomosis is then complete.

Reynolds, in a recent book on sterility, has made the statement that the vas deferens is never at fault as a cause of sterility. He is certainly mistaken in this statement We can tell sometimes before operation if the case is inoperable. Such cases on palpation of the vas show distinct beading. These are nearly always occluded, and therefore inoperable as regards cure.

We all know when operating upon a spermatocele that unless we remove every part of the sac (which means the removal of the small duct that leads into the cyst), we are liable to a recurrence of the spermatocele. We assume

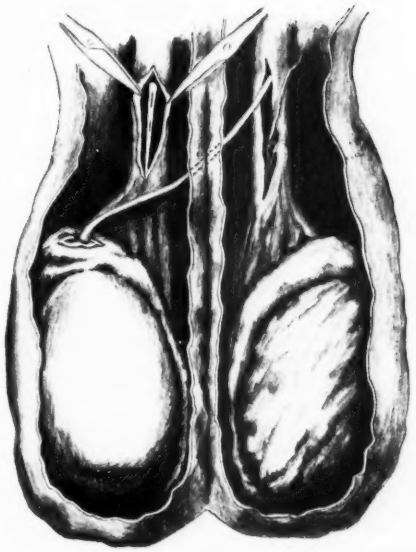


Fig. 5. Anastomosis of the vas through the septum of the scrotum to the opposite side.

that this same condition obtains in the individuals in whom we get a cure; namely, that a sinus is formed between the incised vas and one or more tubules in the epididymis that acts in the same way as the duct that leads to a spermatocele.

A failure at one time, if live spermatozoa are present, and if the vas is patulous, is no contra-indication to a second operation. In some of our most successful results we have had a failure the first time, with favorable outcome at the second operation. The time of the appearance of the spermatozoa varies. We have had individuals who have had actively motile spermatozoa one month after operation, others varying from one month to nearly a year. We do not reoperate under one year, as we have had successes that did not manifest themselves until 8 or 9 months after operation. In one of these cases the first evidence of cure that the patient noted was his wife's pregnancy. He was in a rather unhappy frame of mind until we found he had thousands of spermatozoa.

Before operating, repeated examinations for spermatozoa have been made either by our-

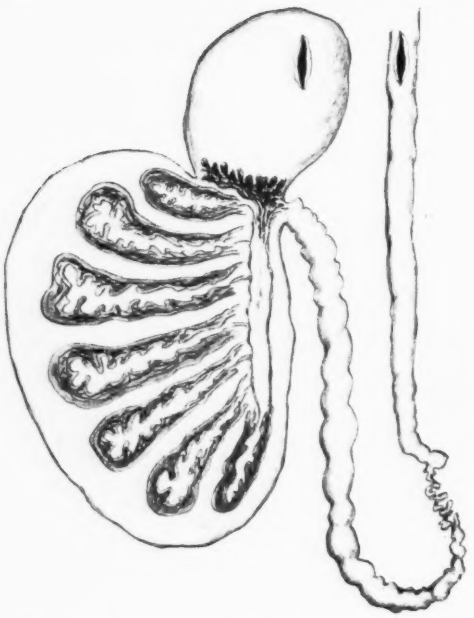


Fig. 6. First step in anastomosing the vas deferens with a spermatocele.

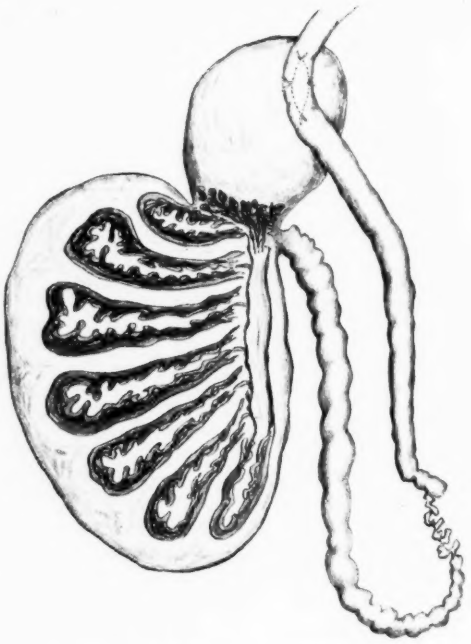


Fig. 7. Completed operation.

selves or by the surgeon referring the patient. Some patients were sent to us as sterile who were found not to be so. I feel, therefore, that we should be very careful in diagnosing sterility in cases wherein too frequent demands have been made on the secretions before examination. It is most important to examine an ejaculated specimen of semen, and not rely on that obtained by massage of the prostate and seminal vesicles.

I have not tried the method advanced by Lespinasse of dissecting out a single tubule and implanting it with a removable suture.

It is important to control all bleeding either by torsion or pressure before making the anastomosis. We have always done a bilateral operation, being careful not to make the incision in the vas too high up, thus giving us a double chance for a cure, and in case of failure the first time, allowing for a subsequent operation.

On the 55 patients here reported there were 67 operations. Twelve patients were reoperated upon because of initial failure. Of these 12, 7 were cured by the second operation. In 3 cases we found in the epididymis of one side actively motile spermatozoa with an occlusion of the vas on this side, the vas appearing as only a fibrous cord. On the opposite side we found no spermatozoa in the epididymis, but the vas was patulous. A crossed anastomosis was done; that is, the patulous vas was brought through the scrotal septum and anastomosed to the epididymis that contained the live spermatozoa. I have been very eager to obtain a success in this type, but unfortunately all three failed of cure.

We have had one interesting case in which one side showed no spermatozoa in the epididymis, while on the opposite side the globus major was replaced by a small spermatocele. An anastomosis was made between the vas and the spermatocele. Within 6 weeks after the operation this patient had live spermatozoa, and in less than a year his wife gave birth to a child.

Another patient had a spermatocele on one side and live spermatozoa in the opposite epi-

didymis. An anastomosis was made between the vas and the spermatocele, as well as the usual one on the opposite side. In this instance we were not successful. We have made three anastomoses directly into the testicle, but without result.

The total number of cases here reported is 55.

In 20 cases the patient had either double occlusion of the vas or else bilateral absence of spermatozoa in the epididymis, while in one case there was absence of the vas on one side and on the other a fibrous cord.

In 3 cases the operations have been too recent to warrant definite conclusions, and in 1 case the result is unobtainable.

Twelve patients in whom active spermatozoa were found, but no occlusion, failed of cure. Among these were 3 crossed anastomosis cases.

Eliminating from the total the 4 non-reportable cases and the 20 cases discovered at the exploratory operation to be inoperable by reason of occlusion of the vas or absence of spermatozoa in the epididymis, we have a remainder of 31. Of these cases 19, or 61.3 per cent, were cured. The figure includes those patients reoperated upon after an initial failure. Twelve of the 19 patients cured begot from 1 to 6 children, and in 1 case impregnation was followed by a miscarriage.

The operation, while tedious, is not dangerous to life. We have always used general anæsthesia. We have felt that, in order to avoid the formation of scar tissue, no local infiltration should be used. The operation cannot compromise the function of an organ that has already proved functionless. If we are fortunate enough to get cures I know of no more grateful patients.

TUMORS OF THE TESTIS

A Brief Series with Special Reference to the Pathology and Clinical Malignancy[1]

DAVID W. MacKENZIE, M.D., F.A.C.S., and MAX RATNER, M.D., Montreal, Canada
From the Urological Department of the Royal Victoria Hospital, Montreal

NEOPLASTIC disease of the testis is universally a rather uncommon condition. Despite this rarity, it has stimulated considerable interest, and has been the subject of a great deal of literature. The discussion has been focused, chiefly, on the origin, nature, and pathology of the tumors.

New-growths of any organ or tissue of the body often present so varied a pathological picture that a clear classification is made impossible. This is even more striking in tumors of the testis, for here we are dealing with an organ which has not only an internal secretion, but also a function to produce germ cells. Many of these cells are aberrant in type and have a tendency to form growths which resemble rudimentary fetuses, the so-called teratomata. These growths are by far the most common tumors of the testis.

From earliest historical times there has been considerable discussion among pathologists as to the nature and origin of tumors of the testis. Although these have never been fully determined, yet a great deal of confusion and controversy has been done away with, as a result of the establishment of two schools of thought. It will be of interest to review, briefly, the historical data which led eventually to the formation of the two theories.

The first work in this field was done by Saint Donat in 1696. He described in detail a testicular tumor, and particularly laid emphasis on the presence of a rudimentary skull. In 1803 Prochaska, and in 1833 Perrone found differentiated tissues, such as teeth, hair, and bone, in a tumor of the testis. Cooper, in 1845, described cystic tumors, and later Curling, divided the growths into benign cystic, and malignant solid types. Incidentally, he was the first one to state that the growths of the testis regularly begin in the rete testis.

It was not until 1854 that Johnson identified in a testicular tumor elements of all three germ layers, namely ectoderm, entoderm, and mesoderm. Langhans and Kocher in 1887, with the aid of microscopic sections, classified the tumors according to their structure. They found that many of the tumors which hitherto were classified as sarcomata and pure carcinomata were really of teratomatous origin. Furthermore, they believed that at least a large number of testicular tumors were of this nature.

Wilms in 1896 made further progress in this work. He showed that all complex tumors of the testis were tridermal, and he classified them under two heads: (1) adult cystic embryomata or teratomata, differentiated, mature, and non-malignant; and (2) solid embryoid teratomata; undifferentiated, immature, and malignant.

Later Ribbert and Ohkubo in 1906 after extensive studies, found that there was a marked tendency for one of the elements of the tridermal tumors to overgrow the others, and produce what appeared to be a simple homologous growth. On further careful examination traces of the other elements were found, thus proving their teratomatous nature. These studies were later corroborated by many eminent authorities, and the general impression was that all tumors of the testis were of teratomatous or tridermal origin.

Chevassu disagreed with this view. While he believed that many of the so-called homologous tumors were definitely teratomata, yet there remained a large number of them (about one half) that did not belong to this tridermal class, but had their origin from another source. He was convinced that these growths were true monodermal or homologous ones, for he was never able to find any trace of the other elements. He described these tumors as soft, medullary, cellular, and with very little stroma. The cells were round or polyhedral, with large vesicular nuclei. This picture according to Chevassu was identical with that found in the adult cells of the seminiferous

[1]Presented before the Clinical Congress of the American College of Surgeons, Philadelphia, October 13-17, 1930.

tubules. He, therefore, concluded that these tumors originate from spermoblasts, and suggested for them the name séminome.

Ewing (14) in 1911, refused to accept an extrateratogenous origin of the above named homologous tumor. He insisted that this common tumor always resulted from a one sided development of a teratoma, and that it did not originate, as Chevassu thought, from adult spermatoblasts.

Thus there were formed the two theories. One headed by Chevassu who believed in the presence of a true, simple, homologous tumor, arising from adult spermatoblasts; and the other sponsored by Ewing, who claimed that the greater number of tumors of the testis were teratomata; and that the so-called homologous tumor belonged to this class. Both schools had many supporters who offered convincing data to prove their own theory. Ewing was supported by Martland, Hinman, Cairns, and Morris, while Chevassu's theory was accepted by Geist, Thalhimer, and Schultz and Eisendrath.

A very important contribution was made by Gordon Bell in 1925. He reported 4 cases of tumor of the testis, the origin of which he believed was from the testicular tubules. The tumors occurred in middle age and grew more slowly than the embryonal tumors. A similar case was reported in 1928 by Stevens and Ewing, who agreed with Bell and admitted an extrateratogenous origin of a small group of malignant carcinomata of the testis.

Summarizing briefly, we see that there has been considerable discussion and controversy regarding the origin and nature of tumors of the testis. As a result of the excellent work by Ewing and Bell, a great deal of light has been thrown on the subject. From all the data now available it seems reasonable to conclude that, in addition to the large group of teratomata, there is a small number of carcinomata of the testis which have their origin from adult tubule cells.

PATHOLOGY

In discussing the pathology of tumors of the testis, we shall first of all review the general conception of teratomata.

A teratoma may be defined as a mixed tumor, containing derivatives of the three

Fig. 1. Photograph of a gross specimen of an embryonal carcinoma of the testicle. Case 1.

germinal layers, epiblast, mesoblast, and hypoblast. Adami (1) best describes this growth by saying that it arises from a totipotent cell which has the power of giving rise to every order of cell in the body. The chief source of these growths is the aberrant sex cell. This origin accounts for the predilection of teratomata for the sex glands.

A typical adult teratoma is one the tissues of which are fully differentiated, and which imitates more or less structures of the adult body. If the tissues are undifferentiated, immature, and do not arrange themselves in orderly fashion, the tumor is said to be atypical or embryonal.

VARIETIES OF TUMORS OF THE TESTICLE

1. *Embryonal carcinomata or embryonal teratomata* (in which one type of tissue predominates). The greater number of tumors of the testis belong to this class. The growths

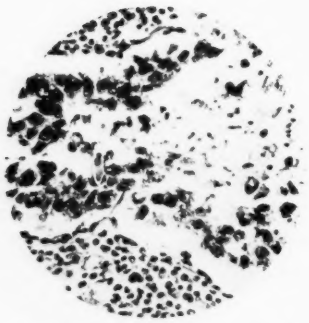


Fig. 2. Photomicrograph of an embryonal carcinoma. Note the large dark staining epithelium-like cells; also the lymphoid cells and areas of necrosis. Case 2.

are soft, rapidly growing, and often show areas of necrosis, hæmorrhage, ulceration, and even suppuration (Fig. 1). These tumors are very malignant, metastasize early, and local recurrence after operation is usual. Microscopically, one finds as a rule large, round or polyhedral cells with vesicular hyperchromatic nuclei. The stroma may be scanty or abundant and areas of necrosis are common findings (Fig. 2).

Under this group we have the adenocarcinoma (Figs. 3 and 4) and the papilliferous adenocarcinoma (Fig. 5). Occasionally the cells are smaller, grow more diffusely, and appear more undifferentiated. The picture may now resemble a lymphosarcoma (Fig. 6).

2. *Teratoid or mixed tumors.* This growth occurs quite frequently and is made up of embryonal structures derived from the three germinal layers. Grossly the tumors are of moderate or large size, and are either solid or made up of many small cysts. Microscopically the cysts are lined with squamous or cylindrical cells. The solid portions contain the embryonal structures: cartilage, bone, connective tissue, and muscle. These tumors are almost always very malignant.

3. *Chorio-epithelioma.* This form of tumor is a very interesting one. Schlagenhaufer, in 1902, reported a case of tumor of the testis which resembled a true chorio-epithelioma. He traced the origin of the syncytial masses from epithelium of the testicular growths; identified Langhans' cells (Fig. 7), and noted the hæmorrhagic character of the metastases.

Fig. 3. Photograph of a gross specimen of an embryonal adenocarcinoma of the testicle. Case 7.

Many similar cases have been reported since. Garbarini, Cooke, and others have observed hypertrophy of the breasts, and secretion of colostrum with this tumor.

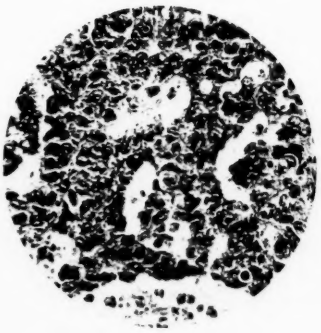
4. *A miscellaneous group of tumors.* Included in this group are the dermoid, fibroma, chondroma, myoma, adenoma, and lymphosarcoma.

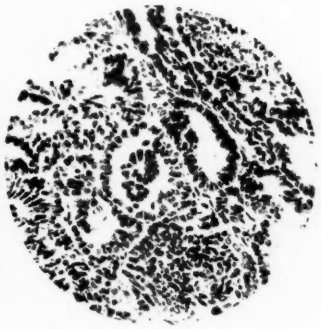
Mention must also be made of the small group of tumors described by Gordon Bell. They occur in middle age, grow slowly, and metastasize very late. Grossly the tumor is of moderate size and multicystic. Microscopically they are small cubical cells growing in a diffuse or slightly alveolar form.

In our series of 13 cases from 1920 to 1930, 10 of them were embryonal carcinomata. Of these 1 was an adenocarcinoma, 1 a papilliferous adenocarcinoma, and 1 resembled a lymphosarcoma. Two cases belonged to the class of mixed tumors, and 1 was a chorio-epithelioma.

METASTASES IN TUMOR OF THE TESTIS

Malignant tumors of the testis metastasize by way of the lymphatics and blood vessels. The greater majority of them are very malignant and metastasize early. The metastases usually appear first in the lumbar glands or in the glands along the spermatic vessels. The





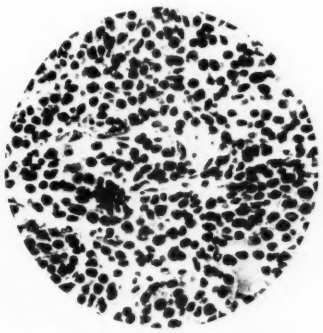


Fig. 4. Photomicrograph of an embryonal adenocarcinoma. Note that the large polygonal cells are arranged in solid masses and loops suggestive of a glandular derivation. Case 7.

Fig. 5. Photomicrograph of an embryonal papilliferous adenocarcinoma. Note the glandular and papilliferous structure. Case 11.

Fig. 6. Photomicrograph of an embryonal carcinoma. Note the small round cells with no definite arrangement. This type of tumor was interpreted by older writers as an alveolar sarcoma. Case 4.

retroperitoneal glands are also involved very quickly, and often the first symptom complained of is a mass in the abdomen. Later the mediastinal (Fig. 8) and supraclavicular glands enlarge. The involvement of the left supraclavicular region is usually more marked, due to common thoracic duct. The growth may even involve the entire scrotum and penis (Fig. 9).

There are very few malignant growths of the body that metastasize as readily by way of the blood vessels as do the malignant growths of the testis. The metastases occur very early and are usually present long before there is any clinical evidence of them. They may involve one or many organs of the body. The most common ones to be involved are the lungs (Figs. 10 and 11), liver, brain (Fig. 12), kidneys (Fig. 13), spleen (Fig. 14), and heart. Invasion of the spermatic and iliac veins by continuous growth has been observed even as far as the heart.

ETIOLOGY

Incidence. Tumors of the testis as compared with new-growths in other parts of the body are rare. Tanner states that it occurs about once in two thousand male hospital admissions. In three hundred thousand cases, both male and female, admitted to the Mayo Clinic, only 50 cases were found. In the London Hospital only 65 cases were discovered in one hundred and ten thousand male admissions. Kelly and Hueper state that up to 1928 approximately seven hundred cases have been reported. Of 207,174 cases, both male and female, admitted to the Royal Victoria Hospital, 27 cases of tumor of the testis were found. Since 1920 there have been approximately fifty thousand male admissions to this hospital, of these only 16 cases were diagnosed as tumor of the testis.

We are reporting a series of 13 cases from 1920 to 1930, which have been proven tumors of the testis by microscopic examination. We have omitted purposely from this series an additional 14 cases of testicular growths. Eight of these were operated upon, but unfortunately the gross specimens and micro-

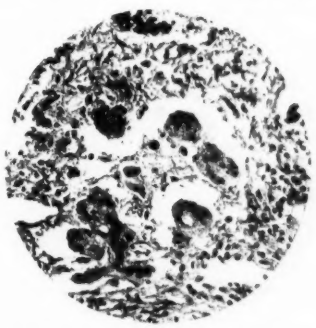


Fig. 7. Photomicrograph of a chorio-epithelioma of the testicle. Note the Langhans' and syncytial cells. Case 2.

Fig. 8. Roentgenogram of chest showing a metastatic growth of the mediastinum. Case 11.

scopic slides have been lost. The remaining 6 cases refused any surgical interference.

Heredity. All authors agree that heredity plays no part in this disease. The family histories in our cases were absolutely irrelevant.

Location. The predominance of tumors of the right or left testis varies with different authors. The majority of growths, however, seem to be of the right testis. Higgins reports 14 cases of the right side, and 9 of the left. Cunningham observed 34 growths of the right testis, and 25 of the left one. In our series, 9 cases were of the right side, and 4 cases of the left.

Bilateral malignant growths are extremely rare. Chevassu reports one case among 128. Kober describes 5 cases. Ochsner and Higgins each report a single case. Councilman reports a case. We have not had a patient with malignant disease of both testes with a possible exception of the following case. One of our patients (Case 6) with an embryonal carcinoma of the right testis involving penis and scrotum, gave a history of having had a left sided orchidectomy performed in Europe, a year and a half previous to the onset of the present illness.

Neoplastic disease of undescended testes is also a very rare occurrence. Keyes and one of us (MacKenzie) in 1917, reported 42 cases of imperfectly descended testis, which were operated upon at Bellevue Hospital. No signs of malignancy were found. Since 1920, 105 cases of undescended testis were operated upon in our department at the Royal Victoria Hospital. There was no evidence of neoplastic changes in any of them.

Trauma. Many consider trauma as an important etiological factor. Only two of our cases gave a history of injury, one 6 months and the other 1 month, prior to the onset of the swelling of the scrotum.

AGE INCIDENCE

The majority of cases of tumor of the testis occur when sexual activity is greatest, that is between the twentieth and fiftieth years. They may occur at any age however. Our youngest patient was 21 years of age; while our oldest was 64 years of age. There were 5 cases between 30 and 40 years of age; 4 between 40 and 50 years; and 2 below 60 years of age.

SYMPTOMS

The symptomatology of tumor of the testis is most uncertain. Many patients consult a physician for a swelling of the scrotum without having any other signs or symptoms. Several of them will complain of a dragging or shooting pain in the groin; others will give a history of repeated aspirations for hydrocele. A small number of patients seek medical aid for shortness of breath, cough, or swelling of one or both legs. Occasionally a patient will also complain of a mass in either groin.

All the patients in our series complained of a mass in the scrotum. Ten cases gave a history of pain. Of these 2 had typical histories of right sided renal colic. Four cases complained of a mass in the groin. There was a history of hydrocele in 2 cases, and of hæmatocele in 1 case. Two patients complained of cough, dyspnœa, and weakness. One patient had typical attacks of Jacksonian epilepsy; autopsy revealed brain metastases.

Fig. 9. Photograph showing a tumor of the testicle with involvement of the entire scrotum and penis. Case 6.

This same patient had painful breasts and colostrum was present. The tumor was a chorio-epithelioma. One patient complained of a mass in the abdomen.

DIAGNOSIS

The diagnosis of malignant disease of the testis is usually made by a process of exclusion. There are four other conditions of the testis which have to be considered, namely tuberculosis, syphilis, hydrocele, and hæmatocele.

Tuberculosis. A carefully taken family or personal history may aid in the diagnosis. The disease usually starts in the epididymis and extends up to the vas. It is only later that the testis becomes involved. The vas and epididymis are usually hard and nodular. Nodules in the prostate and seminal vesicles may be even more important. In advanced cases, the skin of the scrotum is adherent to the mass, and sinuses may form. Bacteriological examination of the urine may reveal acid fast bacilli.

Syphilis. The history of a primary sore may be of value. We must always bear in mind that a malignant growth which is breaking down may give a positive Wassermann reaction. The safest course is to administer anti-luetic therapy. If the lesion is syphilitic it will be influenced in a few days by the treatment.

Hydrocele. It should never be forgotten that hydrocele and tumor often co-exist. Surgeons should always palpate carefully a testis for nodules, after aspirating or during radical cure of a hydrocele. Of course transillumination should always be employed in making a diagnosis.

Fig. 10. Photograph showing multiple metastases in the lungs. Case 9.

Hæmatocele. The swelling is usually a uniform one. It is often very firm and does not transmit light. The Wassermann is negative.

TREATMENT

Castration with or without the radical removal of the lymphatics and glands along the inferior vena cava and aorta is the method of choice in treating malignant disease of the testis. The most important procedure in an orchidectomy is to cut the cord before the tumor is handled in any way. This will help to prevent the possibility of having any malignant cells thrown into the lymphatics or blood vessels. Castration is usually supplemented by X-ray or radium therapy. Coley's

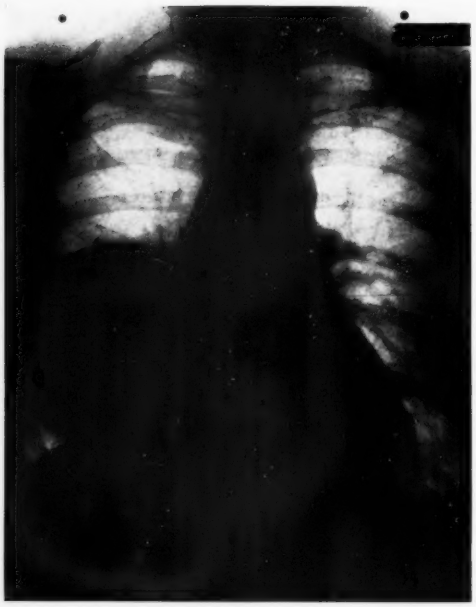


Fig. 11. Roentgenogram of chest showing large metastatic growth involving the right lung. Case 12.

Fig. 12. Section through cerebral hemispheres showing metastatic growth from a chorio-epithelioma of the testicle. Case 2.

serum is also used by some surgeons. In inoperable cases deep X-ray therapy and radium are given.

The simple orchidectomy is a short operation and therefore the operative mortality rate is practically nil. In the radical operation conditions are different. The procedure is a much longer one and therefore a more serious one. The operative mortality rate varies from 10 to 20 per cent. It is hoped, however, that as time goes on the technique will improve with a resulting drop in the mortality rate. Hinman and Beer are great advocates of this operation, and many surgeons are following their technique today. In our clinic both methods have been used with equally unsatisfactory results.

PROGNOSIS

Malignant disease of the testis has a very grave prognosis. Metastases apparently occur very early, and are present in many cases in which clinically they are not demonstrable. Regarding the relative malignancy of the different types of growth, the majority of observers conclude that the mixed tumors are more malignant than the so-called carcinomatous ones. We cannot agree with that belief altogether, for one of our cures of over 5 years had a mixed tumor of the left testis.

The chorio-epithelioma is also very malignant and the prognosis is always grave.

RESULTS

The final results in malignant disease of the testis are poor. Tanner, in 1922, collected 463 cases which were operated upon; of these 81 per cent were dead, and only 5½ per cent were living 4 years or more after operation. He reported another series of 101 cases, and only 18 of these were alive and well 4 years or more after operation. Coley, in 1923, reported a series of 78 cases treated with Coley's serum after castration; 20 were alive and well 4 years or more after operation. Hinman reported 19 cases upon whom the radical operation was performed; 34 were living and well, 6 of them for 4 years or more after operation. This author concludes that 15 per cent are cured by the simple operation and 30 per cent by the radical one.

Fig. 13. Photograph showing multiple metastases in kidney. Case 9.

Fig. 14. Photograph showing metastases in spleen from an embryonal carcinoma of testicle. Case 6.

Higgins, in 1928, reported 23 cases; 16 showed no evidence of metastases before operation. Of this group 8 were dead, 2 could not be traced, and 5 were alive and well, 2 of them for more than 5 years. One was living with metastases 5 months after operation. Seven cases showed clinical evidence of metastases. Of these 2 were dead, 3 were alive and well, 1 of them for more than 2 years, and 2 were living but with metastases.

Dean, in 1929, reported a series of 124 cases. He classified them into (1) primary operable, (2) primary inoperable, (3) recurrent operable, (4) recurrent inoperable, and (5) prophylactic. The operable group of patients were first treated with a course of X-ray and radium therapy, and 1 month later an orchidectomy was performed. Radiation was repeated two or three times at intervals of 2 to 4 months. All patients in the inoperable group were treated with X-ray and radium therapy only. Of the 16 operable cases, 13 are living and well, 4 for more than 4 years. Of the 97 inoperable cases, 28 are living and well, only 8 for more than 4 years.

Cases have been reported where metastatic growths either have disappeared entirely or have been reduced in size after deep X-ray therapy. Dean and Keyes (22) have had a number of such cases. In one of our cases (Case 12) there was a definite diminution in the size of a metastatic growth of the lung, following a course of deep X-ray treatment.

In our series of 13 cases, 3 were inoperable, and were dead within 1 month after admission to the hospital. Two cases are alive and well, 5 years and 4 months, and 4 years and 11 months respectively after operation. One patient (Case 11) is alive 1 year and 9 months after operation, but has metastases in the supraclavicular regions and mediastinum. Another patient (Case 13) is alive 4 months after operation but has developed anuria due to bilateral ureteral obstruction, probably a

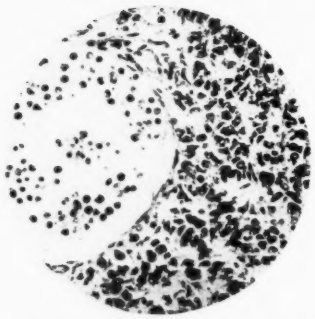


Fig. 15. Photomicrograph of an embryonal carcinoma. Note the tumor cells invading the seminiferous tubule. Case 13.

metastatic growth. Both ureters were catheterized and large hydronephroses were found. Five cases are dead. One was dead 3 months after operation; 1 was dead 4 months after operation; 2 were dead 6 months after operation; and 1 was dead 1 year and 7 months after operation. One case could not be traced. Obviously the results are poor.

We feel that what is most important is a diagnosis of tumor at its earliest stage, and at a time when cure is more probable. This can partly be accomplished if the medical practitioners will palpate carefully the genital organs during their routine physical examination. In addition, we have the health centers and the medical examination for insurance. It is true that we cannot hope for very much, but if only an occasional diagnosis is made in this way, then the efforts will not have been in vain.

CONCLUSIONS

1. Many patients with tumor of the testis consult a physician when metastases have already made their appearance.

2. In a large number of tumors of the testis metastases occur long before there is any clinical evidence of them.

3. Tumors of the testis metastasize very early by way of the blood vessels and lymphatics.

4. Physicians should palpate very carefully the genital organs of patients during their routine physical examination. Every nodule discovered should be looked upon with suspicion.

5. Malignant disease of the testis at best is a very grave disease and the prognosis is poor.

6. The treatment that offers the best prognosis is castration supplemented by deep x-ray therapy.

RÉSUMÉ OF CASE REPORTS

CASE 1. H. S., aged 52 years, was admitted to the hospital June 23, 1920, with the following complaint: mass in the right side of scrotum, cough, and weakness. In 1918, patient first noticed a mass in the right side of scrotum, which has increased in size slowly. He had had a slight dragging pain in the right groin for 6 months prior to admission. He gave no history of injury. His personal and family history was negative.

Examination was negative except for the local condition in the scrotum, and a few small bilateral inguinal glands. The left testicle and epididymis were normal. In the region of the right side of the scrotum there was a firm mass the size of an orange. The surface was slightly irregular and the cord was thickened. The mass did not transmit light. X-ray of chest was negative. Wassermann was negative.

Provisional diagnosis: tumor of the testicle, right.

Treatment consisted in a right orchidectomy.

Patient was discharged cured and could not be traced since.

Pathological report. The gross specimen consisted of a testicle about the size of a small orange, with the cord attached. The cut surface showed yellowish lobulated areas somewhat elevated above the whitish background of probably more or less normal testicular tissue. These areas were somewhat caseous in appearance.

Microscopic examination of the sections revealed an extensive, irregular growth of large, dark staining, epithelium-like cells in bands, strands, and nests. Large, irregular areas of necrotic tissue and band-like arrangements of what appeared to be lymphoid cells were seen here and there. In the capsule the fibrous connective tissue was increased and hyaline.

Anatomical summary: embryonal carcinoma.

CASE 2. H. O., aged 38 years, was admitted to the hospital July 25, 1924, with the following complaint: mass in the right side of scrotum, loss of function of the left arm, cough and soreness of chest, general weakness and loss of weight, and swelling of the right leg. The patient first noticed a mass in the scrotum 9 months prior to admission. He gave no history of injury. Cough and soreness of chest had been present for 3 months. The weakness and loss of weight had been noticed prior to the swelling. The swelling of the right leg had been present for 1 month. The loss of function of the left arm had been first noticed 2 months prior to admission. During his stay in the hospital patient had typical attacks of Jacksonian epilepsy. He had syphilis in

1919, was treated and apparently cured. The family history was negative.

Physical examination revealed an area of consolidation in the upper lobe of the right lung and one at the hilus of the left lung. This was confirmed by X-ray. The neurologists reported a metastatic growth of the right cerebral hemisphere. The Wassermann was negative. The left testicle and epididymis were normal. In the region of the right side of scrotum there was a mass the size of a chicken's egg, nodular and hard. The epididymis seemed to be involved in the mass. The cord was not thickened.

Provisional diagnosis: tumor of the testicle, right.

Patient died the same day, July 25, 1924.

An autopsy was performed and the following facts were noted.

Diagnosis: chorio-epithelioma of the testicle, right, with metastases in liver, kidneys, spleen, lungs, chest wall, brain, and mesenteric lymph glands. The syncytial and Langhans' layers were everywhere in evidence. Another interesting fact was the resemblance of the growth to pregnancy. The breasts were enlarged and painful; and colostrum was present. The testicle was twice its normal size, hard, nodular and reddish brown in color. The cut surface was rough, firm, brown, and grayish brown in color.

Microscopic examination revealed the typical Langhans' and syncytial layers everywhere in evidence. In some areas the syncytial layers predominated. Thick bands of connective tissue separated the oval masses of Langhans' cells, and irregular masses of syncytial tissue were present in the blood clots.

CASE 3. J. H. W., aged 42 years, was admitted to the hospital April 3, 1925, with the complaint of pain and swelling of the left side of scrotum. He had noticed a swelling of the left testicle in 1900 and was told that it was due to tuberculosis. The swelling subsided after treatment and he had no further trouble until the beginning of 1925 when swelling and pain were again noticed. He gave no history of injury. The personal and family history were negative.

Physical examination was negative except for the local condition. The right testicle and epididymis were normal. The left scrotal sac was the size of an orange, tender and tense. The mass did not transmit light and it was impossible to discern the testicle from the epididymis. X-ray examination of the chest was negative. The Wassermann was negative.

Provisional diagnosis: tumor of the testicle, left.

Treatment consisted in left orchidectomy. Patient was discharged cured. He is living and well, 5 years and 4 months after operation.

Pathological report. The specimen consists of a testicle about the size and shape of a goose egg, with thickened and opaque coverings, attached to which are a thickened epididymis and cord. On section the tumor mass shows very prominent, white, thickened, tubule-like structures diffusely scattered throughout a soft, greyish white brain-like substance. The cut ends of the tubule-like structures show a lumen and a thickened wall. The tubules are about the circumference of a large pin. Microscopic examination of sections show a picture in which epidermal structures predominate. These consist of tubule-like structures lined by squamous-like cells which proliferate into several or many layers and then tend to show moderate or extensive keratinization. An occasional gland-like structure is also seen lined by cuboidal or columnar epithelium. These structures are supported by a cellular fibrillar connective tissue stroma.

Anatomical summary: teratoid or mixed growth.

CASE 4. E. L., aged 47 years, was admitted to the hospital September 2, 1925, with the complaint of pain and swelling of left side of scrotum. These symptoms have been present for 1 year. He gives no history of injury. The personal and family history were negative.

Physical examination disclosed negative findings except for the local condition. The right testicle and epididymis were normal. In the region of the left side of scrotum there was a firm mass the size of a lemon. It was smooth and did not transmit light. The Wassermann was negative.

Provisional diagnosis: tumor of the testicle, left.

Treatment consisted in left orchidectomy. He was discharged cured. Patient is alive and well 4 years and 11 months after operation.

Pathological report. The specimen consists of a testicle about the size of a tennis ball. Its tissue is replaced by a soft mass and no normal testicular substance can be made out. Microscopic examination of section shows the tissue of the testicle to be replaced by large round cells with dark staining oval nuclei. The cells are in columns with no definite arrangement.

Anatomical summary: embryonal carcinoma of testicle (round celled tumor).

CASE 5. E. M., aged 64 years, was first admitted to the medical department and later seen by the urological service, August 30, 1926, with the complaint of pain and swelling of the right testicle, and a mass in the left upper quadrant of the abdomen. Patient had first noticed the mass in the scrotum in July, 1926. Pain came on later. The mass in the abdomen was observed 10 days prior to admission. No history of injury was given. The personal and family history were negative.

Physical examination disclosed a large mass in the left upper quadrant of the abdomen, also a mass in the right groin. There was a mass in the right side of scrotum the size of an orange, which was firm and did not transmit light. It was impossible to distinguish the testicle from the epididymis. The left testicle and epididymis were normal. There were also a few small bilateral inguinal glands.

Provisional diagnosis: sarcoma of testicle, right.

Patient died on September 4, 1926. An autopsy was performed.

Pathological report. The specimen consisted of the right testicle which was involved in a large undifferentiated mass the size of a baseball. It was impossible to differentiate the testicle from epididymis. There were secondary growths along the lymph glands of the cord. Microscopic examination of sections revealed that the neoplastic cells consisted of medium sized, round, dark staining elements, comparatively little cytoplasm, and relatively large nuclei. They showed no definite arrangement and lay in strings and clusters in the meshes of a fine fibrillar stroma. Autolysis was a conspicuous feature, but there was no appreciable evidence of lymphoid infiltration.

Anatomical summary: embryonal carcinoma. There were also secondary growths of the retroperitoneal glands, adrenals, and right ventricle of the heart.

CASE 6. T. P., aged 46 years, was admitted to the hospital September 25, 1926, with the complaint of pain and swelling of entire scrotum, more marked on right side; swelling in right groin, and swelling of penis. Patient gave a history of having a left orchidectomy and a radical cure for hydrocele, right, in 1924. Present swelling was noticed just 4 weeks prior to admission, and gradually involved the penis and right groin. No history of trauma was given. The personal and family history were negative.

Physical examination was negative except for a mass in the right groin and large swelling involving the entire scrotum and penis. The skin of the scrotum was red and indurated. The scrotum was the size of a foot ball. It was impossible to palpate any constituents. X-ray examination of chest was negative. The Wassermann was negative.

Provisional diagnosis: tumor of testicle with inguinal metastases, right.

Treatment consisted in right orchidectomy, right inguinal adenectomy, and excision of the scrotum.

Patient died December 12, 1926. Autopsy was performed.

Pathological report. The specimen consisted of (1) an irregular mass of tissue as large as an orange containing the testicle, (2) several pieces of skin with tissue beneath, (3) two almond sized fragments of pinkish tissue. Microscopic examination of the sections showed the growth to be made up of large aggregates of large pale staining, closely packed polyhedral cells with relatively clear, though sometimes finely granular, cytoplasm and quite large, mostly spherical or irregular, vesicular nuclei. No other type of neoplastic tissue was observed. The growth appeared to have completely replaced the tissue as no seminiferous tubules were to be found. A more or less extensive inflammatory reaction completed the picture. The skin and inguinal glands also showed involvement by the growth.

Anatomical summary: large cell embryonal carcinoma of the testicle with metastases in inguinal region.

Autopsy report: embryonal carcinoma of the testicle, right, involving entire scrotum and penis, with metastases in inguinal, pelvic and mesenteric lymph glands, liver, spleen, adrenals, and urinary bladder.

CASE 7. B. C., aged 39 years, was admitted to the hospital January 12, 1927, with the complaint of pain and swelling of the left testicle. The swelling was first noticed at the beginning of 1926. He had had pain in left groin for 2 months prior to admission. No history of trauma was given. Patient had pulmonary tuberculosis in 1925. Took cure. The family history was negative.

Physical examination disclosed signs of a chronic lesion in the upper lobe of the left lung, corroborated by X-ray examination. The Wassermann was negative. The right testicle and epididymis were normal. There was a large rather soft mass in the left side of scrotum. It was irregular, not tender, and did not transmit light. The cord was not thickened. The mass seemed to involve the testicle only. Epididymis seemed free.

Provisional diagnosis: Tumor of testicle, left; pulmonary tuberculosis, chronic, left.

Treatment consisted in left orchidectomy. Patient was discharged cured, but died in June, 1927.

Pathological report. The specimen consisted of a testicle split open to show a rather large, soft growth involving about two-thirds of the substance. The epididymis appeared free grossly. Microscopic examination of sections of the growth showed it to consist of large polygonal cells with large vesicular nuclei and prominent nucleoli. Mitotic figures are prominent. The cells were arranged in solid masses, strings, and loops, suggestive of a glandular derivation.

Anatomical summary: embryonal adenocarcinoma.

CASE 8. A. McL., aged 31 years, was admitted to the hospital March 22, 1927, with the complaint of pain and swelling of the right side of scrotum. Patient first noticed a small swelling in 1922. This did not increase in size until 1926. Pain, dragging in character, also started in 1926. No history of injury was given. The personal and family history were negative.

Physical examination was negative except for local condition. The left testicle was small, the left epididymis was normal. The entire right side of scrotum was filled by a large mass, the size of a grapefruit. The upper part was soft and transmitted light. The lower part was hard, irregular, and did not transmit light. There was a fair amount of tenderness.

Provisional diagnosis: tumor of right testicle.

Treatment consisted in right orchidectomy. Patient was discharged cured.

Patient returned to the hospital in June, 1927, complaining of cough and weakness. He died on July 20, 1927. Autopsy revealed metastases in mediastinum, lungs, and retroperitoneal glands.

Pathological report. The specimen consisted of a large oval mass the size of a grapefruit. It was firm and on section, no definite testicular tissue could be differentiated. The tissue was largely composed of

a grey homogeneous mass. Sections showed the tumor mass to be composed of irregular masses of large pale staining cells. They were immature in type and showed definite mitotic figures. There were only abortive attempts at glandular loop formation, and in most areas they grew in fairly solid masses. There was a considerable amount of immature fibrous connective tissue in some areas while in others this element was quite scarce.

Anatomical summary: embryonal carcinoma.

CASE 9. J. McL., aged 57 years, was admitted to the hospital August 7, 1927, with the complaint of swelling of the left testicle, and a mass in the left groin. The mass in the left testicle was first noticed in the Fall of 1926. The mass in the groin was first seen 3 months prior to admission. No history of pain or injury was given. The personal and family history were negative.

Physical examination disclosed clinical signs of metastases in the lungs and inguinal lymph glands. The right testicle and epididymis were normal. In the left side of scrotum there was a firm mass the size of a small orange. One could not discern testicle from epididymis. The mass did not transmit light. The Wassermann was negative.

Provisional diagnosis: tumor of left testicle with metastases in lungs and inguinal lymph glands.

Patient died a few hours after admission August 7, 1927.

Pathological report. The specimen consisted of left testicle which contained a firm mass the size and shape of a pear. When sectioned the testicle showed almost complete replacement by firm yellowish growth. Microscopic examination of the section showed numerous masses of small round hyperchromatic tumor cells, separating the seminiferous tubules. Mitotic figures were numerous. Some areas showed no fibrous arrangement, others showed a fine fibroblastic reticulum. The cells had no definite arrangement but extended in solid masses.

Anatomical summary: embryonal carcinoma of left testicle, with metastases in lungs, left kidney, inguinal, thoracic, mesenteric and retroperitoneal lymph glands.

CASE 10. J. L., aged 33 years, was admitted to the hospital October 15, 1927, with the complaint of swelling of right side of scrotum, and attacks of severe pain in right loin radiating downward to the right groin. Patient gave a history of being struck in the right side of scrotum in June, 1926. He first noticed swelling in the right side of scrotum in January, 1927. He had had several attacks of typical right renal colic prior to admission to hospital. The personal and family history was negative.

Physical examination showed small palpable bilateral inguinal glands. There was no clinical evidence of glandular enlargement in other parts of the body. The left side of scrotum and its contents were normal. There was a mass in the right side of scrotum, the size and shape of an orange. The mass was hard, smooth, and not tender. It did not transmit light. It was not possible to discern epididymis from testicle. The Wassermann was negative. X-ray examination of the chest was negative.

Provisional diagnosis: tumor of right testicle.

Treatment consisted in right orchidectomy. Following operation patient developed a phlebitis of both legs, which subsided quickly. About 6 weeks after operation patient developed some jaundice and had a marked gastro-intestinal upset. Physical examination revealed a large, hard mass in the right upper quadrant of the abdomen, probably in the liver. Patient left the hospital in January, 1928, in a rather poor condition. He died in April, 1928.

Pathological report. The specimen consisted of a firm goose egg sized mass of tissue which had replaced the testicle and epididymis and a portion of the vas. The growth was quite solid, homogeneous, firm, and yellowish. Microscopic examination of the sections of the growth showed it to be made up of irregularly arranged masses of various types of tissue, including cartilage, fibrous tissue, smooth muscle, myxomatous tissue, and nests of immature ectodermal appearing elements. Occasional areas of more immature and undifferentiated nature were seen, and suggested a reversion on the part of some of the cells to a malignant character.

Anatomical summary: teratoid or mixed growth with malignant degeneration.

CASE 11. H. S., aged 52 years, was admitted to the hospital November 1, 1928, with the complaint of pain and swelling of the right side of the scrotum. Patient gives a history of having a hydrocele on the right side which was tapped and then excised radically in 1927. The swelling soon returned and became progressively worse. The pain had been present for about 4 to 5 months prior to admission. No history of injury was given. The personal and family history were negative.

Physical examination disclosed a few small bilateral inguinal glands. The left side of the scrotum and its contents were normal. There was a large mass filling the entire right side of scrotum. It was the size of a grapefruit, smooth and fluctuant. It did not transmit light. Behind this there was another firm mass which was irregular. The Wassermann was negative. X-ray examination of chest was negative.

Provisional diagnosis: tumor of right testicle.

Treatment consisted in right orchidectomy. Patient was discharged cured.

Patient returned in June, 1929, with a large mass in the left side of the neck, also metastases in the right inguinal region and mediastinum. He was given X-ray therapy to the chest and radium to the mass in the neck, but without beneficial results. He is still alive today but is gradually going down hill.

Pathological report. The specimen consisted of a piece of tissue the size of a grapefruit. Attached to one side was a piece of thick wrinkled skin about 9 centimeters in diameter. Under this skin was a layer of fibromuscular tissue which partially enclosed masses of blood clot. On the inner aspect of the specimen there was an oval mass of soft, spongy,

granular-like, light brown tissue. At one end of this mass was a cystic cavity which had been opened. The wall of the cavity contained hard white nodules. Microscopic examination of the section showed a malignant epithelial growth which tended in certain areas to arrange itself in cystic papilliferous structure, while in other areas it showed merely glandular arrangement or solid aggregates. Quite peculiar to this growth was the tendency, where growing in solid fashion, for the cells to be very elongated while the cystic areas were lined with a much shorter epithelium.

Anatomical summary: papilliferous adenocarcinoma.

CASE 12. A. B., aged 40 years, was admitted to hospital November 4, 1928, with the complaint of pain and swelling of the right side of scrotum, and pain in the right loin. Patient while in the army, in 1918, had what was diagnosed as an acute orchitis, right. It lasted 3 weeks. He had no further trouble until June, 1918, when he developed a right renal colic. Next day he noticed the swelling of the right side of scrotum. He consulted a physician who diagnosed condition as hæmatocele and tapped it. Patient gave a history of injury 1 month prior to the onset of the pain and swelling. The personal and family history were negative.

Physical examination was negative except for the local condition in the scrotum. The left side of scrotum and its contents were normal. On the right side there was a large mass the size of an orange. The upper part was fluctuant and transmitted light. The lower part was hard and did not transmit light. The Wassermann was negative.

Provisional diagnosis: tumor of the right testicle.

Treatment consisted in right orchidectomy. Patient was discharged cured on November 15, 1928.

He was re-admitted on March 24, 1930, complaining of cough and soreness and swelling of the abdomen. General physical examination showed a large mass in the right side of the chest and another large mass in the right side of abdomen, probably metastases in the retroperitoneal glands. He was given deep X-ray therapy with at first good results. There was a definite diminution in size of the tumor in the chest. Later the treatment did not seem to influence the growth to any extent. As a matter of fact patient began to lose ground quickly and died in June, 1930.

Pathological report. The specimen consisted of a large, rounded well encapsulated mass which had been opened. The cut surface of this mass was soft, greyish white, with hæmorrhagic areas, and showed no particular structure. This was taken to be the testicular tumor. To one side of this mass was attached the epidermis, and the somewhat thickened wall of a hydrocele which had been opened. Microscopic examination of the sections showed a malignant epithelial growth which is extremely necrotic, and consisted of irregular masses of rather large epithelial cells with large vesicular nuclei. These were supported by a fibrous stroma with inflammatory cellular infiltration and showed a distinct tendency to arrange themselves in glanular fashion.

Anatomical summary: embryonal carcinoma.

CASE 13. J. B., aged 21 years, was admitted to the hospital June 25, 1930, with the complaint of swelling in the right side of scrotum, and a mass in the right groin. Patient first noticed a small swelling in the right side of scrotum 1½ years prior to admission. The swelling had gradually increased in size. A swelling had been present in the groin for 4 months. No history of injury was given. The personal and family history was negative.

Physical examination showed evidence of a fibroid lesion in the lungs with pleural adhesions. No active tuberculosis was present. X-ray examination of the chest corroborated the clinical findings mentioned. The mass in the right groin was the size of a chicken's egg, it was hard, firm, and attached to the deep tissues. The left testicle and epididymis appeared normal. There was a large, nodular, hard mass in the right side of scrotum the size of an orange. The testicle could not be made out easily and seemed smooth. The mass seemed to involve the epididymis more than the testicle. The Wassermann was negative.

Provisional diagnosis: tumor of right testicle, with metastases in right inguinal region.

Treatment consisted in right orchidectomy, with removal of the inguinal mass. Patient was discharged improved, July 21, 1930.

The mass in the right inguinal region was found to be very large and adherent to the deep tissues. It surrounded the pampiniform plexus and involved the peritoneum. It was removed with great difficulty. A small portion which surrounded the pampiniform plexus was left. Patient was given a course of deep X-ray therapy. He is alive but still has a mass in the right groin which lately has caused him a considerable amount of pain.

Pathological report. The specimen consisted of an irregular pink mass the size of a goose egg, and moderately firm throughout. Near one end was the testicle which, grossly, appeared normal. On section the main mass was found to be homogeneous, glistening and pale yellow in color. Microscopic sections showed the growth to consist of proliferation of immature cells characterized by great variation in size and shape, with hyperchromatic nuclei and often comparatively little cytoplasm. Occasionally the cells were elongated and appeared to have a fibrillar structure; others were more spherical and epithelial in character. Occasional giant forms were seen. There was a distinct tendency to necrosis. Sections through the apparently normal testicle showed definite involvement at the rete with encroachment on the seminiferous tubules (Fig. 15). Sections of the inguinal glands showed the tissue to be completely replaced by growth.

Anatomical diagnosis: embryonal carcinoma.

Patient returned to the hospital on September 13, 1930, with anuria due to bilateral ureteral obstruction. This resulted probably from metastases of the

retroperitoneal glands pressing on the ureters. Cystoscopic examination revealed large bilateral hydronephroses. Both ureteral catheters have been left *in situ*. He is still in the hospital, with indwelling catheters. His general condition is poor.

BIBLIOGRAPHY

1. ADAMI, J. G. Principles of Pathology. General Pathology. 2d ed., p. 653. London, 1909.
2. BELL, GORDON. Tumors of testicle. Brit. J. Surg., 1925, xiii, 282.
3. BEER, E. Tumors of the testicle. Chapt. 17. Modern Urology by Cabot. 1918.
4. CAIRNS, H. W. B. Neoplasm of testicle. Lancet, 1926, ccx, 845.
5. CHEVASSU, M. Tumeurs du Testicale. Thése de doct., Paris, 1906.
6. COLEY, W. B. Cancer of testicle. Ann. Surg., 1925, lxii, 40.
7. COOKE, J. V. Johns Hopkins Hosp. Bull., 1915, xxxvi, 215.
8. COOPER, ASTLEY. Diseases of Testis. Philadelphia, 1845.
9. COUNCILMAN, W. T., and LOVETT, R. W. Case of double teratoma. J. Exper. Med., 1897, ii, 427.
10. CUNNINGHAM, J. H. New growths developing in undescended testicles. J. Urol., 1921, v, 471.
11. CURLING, T. B. Diseases of Testis. London, 1878.
12. DEAN, A. L., JR. Treatment of teratoid tumors of the testis with radium and X-ray. J. Urol., 1929, xxi, No. 1.
13. DONAT DE SAINT. Observation d'une prétendre grossesse d'homme. Lu à l'Acad. de Sciences, 1697. Cited by Verneuil in Bull. Soc. Chir., Paris, 1867.
14. EWING, J. Teratoma testis and its derivatives. Surg., Gynec. & Obst., 1911, xii, 230.
15. Idem. Neoplastic Diseases. 3d ed., 1928.
16. GARBARINI, E. Il Morgagni. 1899. Vol. xli, part 1, 137.
17. GEIST, S. H., and THALHIMER, W. Histopathology of carcinoma of testicle. Ann. Surg., 1917, lxvi, 571.
18. HIGGINS, C. C. Malignant tumors of testicle. Ann. Surg., 1928, lxxxvii, 263.
19. HINMAN, F., GIBSON, T. E., and KUTZMAN, A. Radical operation for teratoma of testis and analysis of seventy-nine cases. Surg., Gynec. & Obst., 1923, xxxvii, 429.
20. JOHNSON, G. Case of encephaloid cancer affecting a testicle which has been retained within the cavity of the abdomen. Med. Chir. Treatise, London, 1854.
21. KELLY, J. E., and HUEPER, W. C. Carcinoma of testicle. Ann. Surg., 1928, lxxxviii, 1079.
22. KEYES, E. L. Malignant tumors of the testicle, diagnosis, prognosis, and treatment. Am. J. Roentgenol., 1926, January.
23. KEYES, E. L., and MACKENZIE, D. W. The operative treatment of cryptorchidism. J. Am. M. Ass., 1917, lxviii, 349–351.
24. KOBER, G. M. Sarcoma of the testicle. 1899, cxviii, 535.
25. KOCHER, T. Die Krankheiten der maennlichen Geschlechlsorgane. Stuttgart, 1887.
26. LANGHANS, T. L. Deutsche Chir., Stuttgart, 1887, Lief. 50 B.
27. MORRIS, J. H. Tumors of testicle. Arch. Surg., 1927, xv, 530.
28. OCHSNER, A. J. Tumors in undescended testicles. Surg. Clin., 1917, i, 689.
29. MARTLAND, H. S. New growths of the testis. Surg., Gynec. & Obst., 1919, xxviii, 486.
30. OHKUBO, H. Entwick. 1908, xxvi, 509.
31. PERRONE, DE ANDRE. Cited by Verneuil in Bull. Soc. Chir., Paris, 1867.
32. PROCHASKA, C. Cited by Verneuil in Bull. Soc. Chir., Paris, 1867.
33. SCHLAGENHAUFER, F. Wien. klin. Wchnschr., 1902, xv, 571.
34. SCHULTZ, O. T., and EISENDRATH, D. N. Histogenesis of malignant tumors of testicle. Arch. Surg., 1921, ii, 686.
35. STEVENS, A. R., and EWING, J. Adeno-carcinoma of testis in adult. Ann. Surg., 1928, lxxxviii, 1074.
36. TANNER, C. O. Tumors of the testicle. Surg., Gynec. & Obst., 1922, xxxv, 565.
37. WILMS, M. Die Teratoiden Geschwueltse des Hodens Beitrage. 1896, xix, 233.

THE PATHOLOGY OF THE SPREAD OF CANCER OF THE RECTUM, AND ITS BEARING UPON THE SURGERY OF THE CANCEROUS RECTUM[1]

W. ERNEST MILES, F.R.C.S. (Eng.), F.A.C.S., LONDON, ENGLAND

IT appears to be a fairly common belief that cancer is at first a local disease and remains localized[2] for a considerable time. Although this may be true in certain forms of squamous carcinomata I am quite convinced that it does not hold good for the majority of the adenocarcinomata and especially for adenoid cancer of the rectum. In the latter it is a common experience to encounter widespread dissemination in the perirectal tissues and even in the abdominal cavity in clinically early examples of the disease; so that it seems probable that these carcinoma cells become detached from the primary growth almost synchronously with its inception and, finding their way by means of the lymph channels into the surrounding tissues, form more or less distant metastases.

The assumption that cancer remains localized for a definite period of time after its inception is no doubt responsible for the faith reposed in radium as a curative agent by those who are interested in radium therapy. So far as the rectum is concerned, the treatment of cancerous growths by radium has as yet been extremely unsatisfactory, it being my experience that, whereas local improvement may sometimes result, rapid and widespread dissemination takes place in the surrounding tissues owing to stimulation of the distant metastases. Thus it happens that despite the competition of radium therapy in the treatment of malignant disease, rectal carcinoma still remains within the domain of surgery. It behooves us, therefore, to endeavor to ascertain the best means by which surgical treatment can be carried out.

An operation undertaken for the cure of cancer, to be effective, must be based upon pathological findings in regard to the spread of cancer from the primary growth to surrounding tissues.

If the field of operation does not embrace the tissues pathologically known to be prone to invasion by cancer cells which have become detached from the primary focus, then the operation will be doomed to failure, because it will not prevent recurrence.

The whole question, therefore, of the surgical treatment of cancer of the rectum hinges upon the knowledge we have been able to obtain: first, of the manner in which cancer of the rectum spreads, and, second, of the paths along which that spread takes place.

PATHOLOGY

The adenocarcinoma is the only type of cancer that is met with in the rectum, the epithelial elements being derived from the cylindrical cells of Lieberkuhn's follicles.

Although there is only one type of carcinoma of the rectum, four distinct clinical varieties can be recognized, differing in physical characteristics and in degree of malignancy. We may call these (a) the papilliferous carcinoma; (b) the common adenoid carcinoma; (c) the colloid carcinoma; and (d) the melanotic carcinoma.

The papilliferous carcinoma. The growth resembles an ordinary simple papilloma, but at the base of the tumor, the epithelial elements proliferate irregularly and penetrate the muscularis mucosæ. Such a growth extends rapidly upon the surface and soon involves the whole circumference of the bowel. Owing to the exuberance of the growth, the lumen of the bowel becomes obstructed long before infiltration of the muscular coat has progressed to any marked degree. Consequently, these growths are not particularly malignant and seldom give rise to extramural metastases unless they have been in existence for a considerable time. When surface necrosis has occurred the retrorectal lymph glands may become enlarged from septic absorption, but rarely are they the seat of cancerous deposit. Hence the papilliferous carcinoma seldom recurs after removal, even by an operation of a

[2]By the term localized, is meant that the epithelial elements remain confined within the precincts of the primary tumor.

[1]Presented before the Clinical Congress of the American College of Surgeons, Philadelphia, October 13–17, 1930.

most restricted type. As a rule, symptoms of obstruction, due to blocking of the lumen of the bowel by the exuberant growth, lead to early detection before extramural dissemination has had time to develop.

The adenoid carcinoma. The great majority of cancers of the rectum are of this kind. They are usually seen as sessile tumors involving the mucosa and submucosa. In the majority of cases the growth is flattened, the transverse diameter being greater than the longitudinal. The tumor increases in size in all directions and though at first freely movable upon the muscular coat, soon infiltrates and becomes adherent to it. It is impossible to say how soon after the inception of the neoplasm deep infiltration takes place but probably it occurs within 6 months. As the growth increases in size, surface disintegration occurs and a definite ulcer, exhibiting the well known malignant characters, is formed. Even at this early stage the retrorectal lymph glands are usually invaded, thus showing that extramural dissemination of cancer cells takes place while the growth is still in a clinically early stage of development. As more of the circumference of the bowel becomes involved, the ulcer deepens and assumes a crateriform appearance with nodular, everted, and indurated edges. When the ulcer has extended nearly all round the bowel, stenosis of the lumen is produced and then the stage is reached when symptoms of impending obstruction make themselves manifest. The adenoid cancer gives rise to extramural metastases which may be widespread while the growth is yet in an early stage clinically, and therefore must always be considered as highly malignant. It will inevitably recur after a restricted operation.

The colloid or mucoid carcinoma. This is merely a degenerative stage of the preceding varieties, both the epithelial elements and the connective tissue undergoing mucinoid change. Such growths are extremely malignant and are apt to recur rapidly even after the most comprehensive operation.

The melanotic carcinoma. This variety of rectal cancer is fortunately extremely rare and is the most malignant of all. I have met with only three examples of it among nearly twelve hundred cases of cancer of the rectum. The growth is found either in the anal canal or at the lowermost part of the ampulla and generally upon the posterior wall, Macroscopically it differs little in general appearance from the ordinary adenoid cancer, but microscopically the presence of pigmentation in the epithelial and connective tissue elements reveals the true nature of the growth. The pigmentation, however, may be absent from portions of the growth so that unless serial sections of the tumor are made, the melanotic nature of the growth may escape detection. Rapid dissemination takes place giving rise to metastases throughout the body. The growth invariably recurs after removal.

THE SPREAD OF CANCER OF THE RECTUM

An adenocarcinomatous tumor of the rectum, when observed in an early stage, is confined to the mucous membrane and the submucous tissue. The tumor is sessile and is readily movable upon the subjacent muscular coat of the bowel. It gradually increases in size, and during the process of growth spreads in three distinct ways: (a) by direct extension through continuity of tissue; (b) through the venous system; and (c) by means of the lymphatic system.

Spread by direct extension through the continuity of tissue. This takes place in two directions: (1) on the mucous surface of the bowel progressively from its entire margin, and (2) through the thickness of the bowel wall. The marginal increase is generally greater and more rapid in the transverse direction than in the longitudinal axis of the bowel. It is not uncommon to find that, whereas nearly the whole of the circumference of the ampulla has been invaded, the extent of the growth longitudinally is less than 2 inches. The growing edge undermines the more normal mucous membrane extending in the submucous tissue deep to the muscularis mucosæ. Such surface extension is usually slow; thus, in the ampulla, for instance, it probably takes 6 months for the growth to travel round a quarter of the circumference in an average case. It is difficult, however, to determine how long a growth may have existed, and to what extent the circumference of the bowel is usually involved before the earliest symptoms indicative of its

presence manifest themselves, as there are so few data available.

I have had the opportunity, however, of observing the gradual development of cancerous growths of the rectum in 4 patients who, though seen when the growth was in a comparatively early stage of development, either refused operative treatment or were unable to submit to it for some reason or other. In all of these patients the growths, when first seen, were confined to the mucous coat, and were freely movable upon the subjacent muscular coat, thus indicating that, up to that time, infiltration of the muscular coat had not occurred. These growths all became adherent to the muscular coat before half of the circumference of the bowel had been encompassed. At the expiration of one year after the date of the first examination the extent of the circumference of the bowel which had become involved was five-sixths, four-fifths, four-fifths, and three-fourths, respectively. From these observations it may be inferred that, in the ampulla of the rectum at all events, the involvement of the circumference of the bowel is a comparatively slow process, and that by the time that three-quarters of the circumference has been involved the growth has been in existence for about 18 months. The extent, therefore, of the circumferential involvement may be taken as an index of the duration of the disease.

While surface extension is slowly progressing, the more important deep infiltration of the muscular coat of the bowel is taking place. This infiltration probably begins at the center or oldest part of the tumor, but because of the fact that surface extension takes place unequally, it may happen that the most fixed and indurated portion is eccentric. The fact that the center of the growth is opposite an important structure, such as the prostate or base of the bladder, does not imply that penetration of the bowel is occurring at that point, and that actual invasion of the structure has taken place, although the rectum may appear to be adherent to it.

Direct extension through the muscular coat of the bowel appears to be also a slow process. So soon as the bowel wall has been completely penetrated, the growth invades the perirectal fat through which it extends until it reaches the fascia propria of the rectum. According to my observations upon this point the fascia is not usually invaded until the growth has existed long enough for more than three-quarters of the circumference of the ampulla to have been encompassed, thus indicating that the disease has existed for about 18 months. It is only after penetration of the fascia that invasion of neighboring structures such as the sacrum, uterus or vagina, the prostate, or bladder can take place; and it would appear that involvement of adjacent structures by direct extension does not occur for at least a year after the first appearance of objective symptoms. It will be seen, therefore, that the mode of spread through continuity of tissue is a comparatively slow process, and that direct invasion of neighboring structures does not take place until the growth in the rectum has involved the greater part of the circumference of the bowel.

If extension of cancer through continuity of tissue were the only or even the usual mode of spread from the rectum, the surgical treatment of the disease would be quite simple because, unless the growth has extended beyond the confines of the fascia propria, a restricted operation, entailing nothing but the removal of the musculomembranous tube containing the cancer in its interior, would be all that was necessary to rid the patient completely of his disease. Unfortunately, however, other and more important modes of spread take place simultaneously and with greater rapidity, leading to distant dissemination even when the primary growth is still in an early phase of development.

Spread by means of the venous system. There is no doubt whatever that cancer cells occasionally become disseminated by means of the venous system. Microscopical specimens sometimes afford evidence of the direct invasion of the interior of venous radicles by a mass of cancer cells, and it is therefore easy to understand how such cells, having become detached from the main body, may be swept into the venous system and carried to a great distance from the primary growth. As the rectal veins belong to the portal system, cancer cells penetrating them are carried straight to

the liver. The metastasis thus produced by an embolus of cancer cells is single and is usually situated in the middle of the right lobe of the liver. Consequently in some instances, even in comparatively early growths, that is to say, when they are small, circumscribed, mobile, and involving considerably less than one-half of the circumference of the bowel, and from which direct extension into the perirectal tissues cannot be ascertained to have taken place microscopically, a metastasis in the liver may be the only evidence of dissemination. Early metastasis in the liver of this kind, however, is not usually associated with general liver enlargement, and, therefore, it is not possible to ascertain its existence even when the abdomen is open. Fortunately, this mode of spread is extremely rare and consequently we can afford to disregard the possibility of its occurrence when considering operability, because we are unable to control it either by surgical or by any other means. Definite liver metastasis is generally a late manifestation, so that when the liver is obviously enlarged in a case of cancer of the rectum the local disease is already far advanced and quite hopeless so far as any operative treatment is concerned.

Spread by means of the lymphatic system. By far the most important of the modes of dissemination of cancer cells in the perirectal tissues and to distant parts is that through the lymphatic channels. A thorough knowledge of the anatomy of the lymphatic system is essential to the performance of any radical operation for cancer.

ANATOMY OF THE LYMPHATICS OF THE RECTUM

Anatomists describe the rectal lymphatics in three groups, intramural, intermediary, and extramural.

1. The intramural lymphatics are contained in the wall of the rectum and consist of two distinct networks, one situated in the submucous tissue and the other between the muscular layers. The two networks communicate freely with one another by means of short radial channels which pass through the circular muscular coat. The submucous network of the ampulla is said to be continuous above with that of the pelvic colon and below with a similar network in the anal canal. The latter is also in communication with the lymph plexus in the subcutaneous tissue of the perianal skin, from which collecting stems pass forward, in the furrow between the perineum and the inner aspect of the thigh, to terminate in the innermost of the horizontal set of inguinal glands. The intermuscular network of the rectum is also said to communicate above with that of the pelvic colon and below with the lymphatics of the external sphincter muscle. The collecting stems traverse the external muscular coat of the rectum and terminate in the lymph channels of the intermediary system.

2. The intermediary lymphatic system consists of two parts, namely, a subserous network in the portion of the rectum which is covered by peritoneum, and a lymph sinus, situated between the external muscular coat and the perirectal fat, in that part of the rectum which does not possess a peritoneal investment. This lymph space is occupied by a delicate wide meshed reticulum of fine strands of connective tissue and can always be demonstrated in any specimen of the rectum which has been removed together with its covering of perirectal fat. The collecting stems from the intermuscular network after traversing the external muscular coat, empty themselves directly into this lymph sinus so that a detached cancer cell after entering the sinus may wander to any part of it before entering the extramural lymphatic system.

3. The extramural lymphatic system is the most important of the three. The collecting stems from the lymph sinus form an extensive plexus and enter into relation with the anorectal glands of Gerota, which are scattered over the surface of the rectum among the branches of the superior hæmorrhoidal vessels. The efferents from this plexus and from the anorectal glands pass to their ultimate destination in three directions, namely, downward, laterally, and upward.

The downward efferents traverse the fatty tissue of the ischiorectal fossa in company with the inferior hæmorrhoidal vessels, enter into relation with a small group of lymph nodes situated close to the exit of Alcock's canal, then pass through the canal and empty themselves into the internal iliac glands. The

lateral efferents enter a plexus situated between the levator ani muscles and the pelvic fascia from which collecting vessels pass to the obturator gland at the upper border of the obturator foramen. The efferents from the obturator gland pass to the internal iliac glands and to the innermost of the group of glands accompanying the external iliac vessels.

The upward main efferents accompany the superior hæmorrhoidal veins, enter the lowermost mesocolic glands, then accompany the inferior mesenteric vein as it lies in the parietal border of the pelvic mesocolon, and finally enter the group of glands situated at the bifurcation of the left common iliac artery and also the median lumbar (aortic) glands. Some of the efferents from the uppermost part of the plexus enter into relation with the paracolic glands situated along the mesenteric border of the pelvic mesocolon, from which collecting stems accompany the sigmoidal vessels to end in the median lumbar glands.

Such being the anatomical arrangement of the lymphatics in connection with the rectum, the tissues through which the lymphatics pass are liable to be invaded by cancer cells which have become detached from the primary growth.

These detached cancer cells are responsible for the formation of metastases and it is a curious fact that, whereas metastases are commonly met with in the tissues outside the rectum, they are never seen in the wall of the rectum. Now, if there were a continuous submucous plexus of lymphatics, such as has been described anatomically, we should expect, in cancer of the rectum, that visible metastases in the mucosa, either singly or in chains, would be of frequent occurrence both above and below the growth. The inference then is that the spread of cancer cells in the submucosa is very limited in extent and does not extend more than a few lines beyond the microscopical growing edge of the neoplasm. It is probable that the lymphatics of the mucosa do not exist as a continuous plexus, but are arranged as decussating arborescents from which collecting stems pass straight through the circular muscular coat to join the intermuscular plexus. Spread in the latter is just as limited so that we may conclude, from clinical as well as from histological findings, that the intramural spread of cancer of the rectum is always of comparatively trivial extent. It is also probable that detached cancer cells pass through the bowel wall somewhat rapidly by means of the intramural lymphatic system, and gaining access to the external lymphatics give rise to extramural metastases scattered over a fairly wide area, long before the muscular coat has been penetrated by direct extension of the growth.

Cancer cells having become detached from the growing edge of the primary growth pass through the submucous and the intermuscular systems and so gain access either to the subserous network or to the lymph sinus. Arrived in the subserous network these detached cancer cells form plaques in the peritoneum covering the bowel; when, however, they enter the lymph sinus they readily find their way into the extramural lymphatic system and give rise to metastases scattered over a wide area.

The path along which these escaped cells travel is determined by the direction of the current in the lymphatic channels which have been invaded. It must be borne in mind, however, that the course taken by these cells is not entirely controlled by anatomical considerations. Thus it may happen that cancer cells derived from a growth in the rectum, wherever situated, may traverse the lymphatics in a downward, lateral, or upward direction, or in all of them simultaneously. During the transit the progress of these cells may be arrested at any point in the region traversed by the lymphatics and so lead to the formation of nodules. The various tissues through which the extramural lymphatics pass, therefore, are prone to metastatic deposit which may either be recognizable with the naked eye or may exist in a microscopical state.

When estimating the possible extent of the spread of cancer it may be regarded as an axiom that whenever a visible metastasis exists, other metastases, which cannot be recognized without the aid of the microscope, also exist along the course of the lymphatics at points more distant from the site of the primary growth.

The extramural paths along which the spread of cancer cells takes place may be

considered in three divisions, remembering that communications exist between them.

1. *The zone of downward spread.* The structures comprised in this zone are the perianal skin, the ischiorectal fat, and the external sphincter muscle. Owing to the free intercommunication between the lymphatics of those structures and the efferents from the rectum, it is easy to understand how the progress of a detached cancer cell may be arrested at any point of that extensive network. It is a very difficult matter to detect such isolated cancer cells even when a large number of serial microscopical sections have been made but their presence has been revealed often enough to establish the fact beyond doubt that these structures are liable to be invaded during the process of dissemination. Moreover, clinical records of cases that had been operated upon by the restricted method of perineal excision afford ample evidence that the perianal skin and the ischiorectal fat were the common seats of recurrent growth.

2. *The lateral zone of spread.* The lymphatics of the levator ani and the coccygeus muscles, the pelvic peritoneum, the prostate gland, the base of the urinary bladder, the cervix uteri, and the base of the broad ligaments enter into relation with the extensive lymphatic network which is situated between the levator ani muscles and the pelvic fascia. These structures, therefore, constitute the lateral zone of spread because cancer cells which have found their way into the network may form metastases in them. The levatores ani are especially prone to invasion by cancer cells which have gained access to the extramural lymphatic system so that they should always be completely removed when a cancerous rectum is excised.

The pelvic peritoneum is also especially liable to invasion. I have observed plaque deposits in the peritoneum of the pelvic floor upon so many occasions that it would not be an exaggeration to say that there is not a portion of it, from the middle line to the brim of the true pelvis, that has not been implicated. This is no doubt due to the fact that the peritoneum in this locality is in close relationship with the extensive lymphatic network situated between the levatores ani and the pelvic fascia. Accordingly it is essential that the peritoneum of the entire pelvic floor, as far as the brim of the true pelvis on both sides, should be removed in every case of extirpation of the cancerous rectum.

3. *The upward zone of spread.* The tissues of the zone are the retrorectal (lowermost mesocolic) glands, the pelvic mesocolon in its entirety, the paracolic glands, the glands situated at the bifurcation of the left common iliac artery, and the median lumbar (aortic) glands. Since the majority of the efferent lymphatics, which form the intramural lymphatic system, either pass through or terminate in the structures contained in the zone, it follows that these structures constitute the principal paths by which cancer cells spread from primary growths in the rectum. In fact this is the most constant and, therefore, the most important of all the routes of spread. We find either macroscopic or microscopic metastases scattered throughout the zone in practically all cases of cancer of the rectum even when the growth is in an early state of development.

In some instances the retrorectal glands are obviously enlarged and can be readily felt, but, in the majority of cases, though the fresh specimen is carefully palpated, it is extremely difficult to be certain whether the glands are enlarged or not. Nevertheless, when these specimens have been hardened and dissected, the involvement is evident. Moreover, microscopical examination of the glands invariably shows that one or more of them have been invaded by cancer cells. It sometimes happens that a gland may be free from deposit although the tissues surrounding it are definitely invaded. In such a case if the glands alone were examined and found to be free from deposit, an erroneous conclusion as to the absence of extramural spread might be arrived at and a more hopeful prognosis, in regard to the possibility of recurrence taking place in adjacent structures, might be given than would be warranted if a more thorough examination had been made. Carcinomatous deposits in the retrorectal glands also occur in cases of cancer of the pelvic colon, thus illustrating downward spread from that locality.

The pelvic mesocolon, throughout its extent, is particularly liable to be the seat of

metastases. It must be borne in mind that invasion by cancer cells may exist in the microscopical state despite the absence of visible metastases and, therefore, it is just as important to remove the whole of the structure at an operation for cancer of the rectum as it is to clear the axilla thoroughly during an operation for cancer of the breast. The parietal border of the pelvic mesocolon, between the layers of which the inferior mesenteric vessels are situated, is most frequently invaded. The efferent lymphatics from the retrorectal glands accompany these vessels on their way to the glands grouped at the bifurcation of the left common iliac artery, and constitute the principal route along which cancer cells from the rectum are carried by the blood stream. At any point along this line metastases may develop, either singly or in chains. There is scarcely a part, however, of the pelvic mesocolon in which I have not observed metastases so that I regard the whole structure as highly dangerous tissue.

The paracolic glands which are situated along the mesenteric border of the pelvic colon are often the seat of metastatic deposit. It might be expected that the involvement of these glands would take place from one to the next in series progressively but this never happens because a continuous chain of affected glands is never seen. When an involved paracolic gland is discovered, it is generally isolated and is situated at a considerable distance from the primary growth.

It is not uncommon to find an infected gland several inches above the rectal growth as the sole evidence of spread along the mesenteric border of the pelvic colon. Instead, therefore, of spread taking place from gland to gland along the chain, it is probable that the cancer cells first follow the course of the lymphatics accompanying the inferior mesenteric vessels and, then, owing to blockage of the normal lymph stream by metastatic deposits, grow continuously or are carried by reversed flow along the lymphatic vessels of the pelvic mesocolon toward the colon, where they are ultimately arrested in one of the paracolic glands. When, therefore, the rectum, together with part of the pelvic colon, has been removed by a perineal method of excision, it is quite possible that an infected paracolic gland, above the level of the point of section of the bowel, may have been left behind, despite the fact that a careful examination of all the paracolic glands contained in the specimen has failed to demonstrate evidence of infection. Even the extensive removal of the pelvic colon by means of the abdominoperineal operation may sometimes fail to include an infected paracolic gland when situated many inches above the level of the primary growth. As an example of this, the following case is worth mentioning. A female, aged 50 years, was admitted into the Cancer Hospital with a carcinomatous stricture at the rectosigmoidal junction. When the abdomen was opened, the bowel, just above the peritoneal junction in Douglas's pouch, was found to be puckered by a narrow constricting band, the type of cancer so commonly met with in this situation. There was no macroscopic evidence of extramural spread. The radical abdominoperineal operation was performed, the whole of the pelvic colon together with its mesocolon being removed. Ten inches of bowel above the level of the growth was excised. Subsequent dissection of the specimen showed that the retrorectal glands were the seat of metastatic deposit and that the paracolic glands were not involved. Nineteen months later a recurrent nodule developed in the lower margin of the colostomy opening. There can be no doubt, therefore, that a paracolic gland, situated immediately above the point of section of the bowel, and already the seat of an invisible metastasis, escaped removal at the time of the operation.

It is evident, therefore, that the dissemination of cancer cells by means of the extramural lymphatic system is more widespread and of much greater consequence than that which takes place along the intramural lymphatics. Moreover, it appears that, of the three zones of possible extramural spread, the upper zone is the most important because secondary deposits are always present, visible to the naked eye, or discernible by the microscope.

As the result of (a) noting the position of metastases during the performance of operations; (b) observing the locality affected by

recurrent growth either clinically or during the performance of secondary operations; (c) recording the extent and position of metastases in cases in which operations were abandoned on account of their presence; (d) studying the postmortem findings in regard to the spread of cancer in patients who had died from advanced and inoperable cancer; and (e) following the detailed examinations, macroscopic and microscopic, of specimens removed by operation, it has been possible to map out with considerable accuracy the tissues that are liable to metastatic deposit during the progress of the disease and to recurrence after restricted operations. The tissues chiefly concerned in the spread of cancer of the rectum are the ischiorectal fat, the levatores ani, the pelvic peritoneum, and the pelvic mesocolon. Pathology teaches us that they may be the seat of metastatic deposits even when the growth in the rectum is in a clinically early stage, and that unless these highly dangerous tissues are completely removed in every case in which an operation for removal of the cancerous rectum is undertaken, postoperative recurrence will be a rule to which there will be few exceptions.

THE BEARING OF PATHOLOGY UPON THE OPERATIVE TREATMENT OF CANCER OF THE RECTUM

The efficacy of an operation for cancer is measured by its recurrence rate. If a postoperative recurrent growth be found in the neighborhood of the operation field, then either the disease had advanced beyond the possible limits of the operation or the scope of operation was not sufficiently comprehensive to embrace the whole of the invaded removable tissue. We have seen that the chief path by which extramural spread from a cancerous growth in the rectum takes place is along the course of the inferior mesenteric vessels and in the substance of the pelvic mesocolon. These structures are out of reach of any operation undertaken solely from the perineum, no matter what method of exposure be employed, so that it is not to be wondered at that a high recurrence rate has prevailed after perineal methods of excision.

My early perineal excision operations were of the restricted type in vogue at that time. They consisted of an exposure by means of excision of the coccyx, narrow removal of the perianal skin, scanty removal of the ischiorectal fat, division of the levatores ani close to their attachments to the rectum, and division of the bowel an inch or so above the upper margin of the growth. Recurrence ensued in every instance, so that the recurrence rate of that type of operation was exactly 100 per cent.

By extending the scope of the operative procedure in successive series I ultimately arrived at a removal which was the most complete that it was possible to carry out from the perineum. The type of operation was as follows: preliminary colostomy, subsacral Kraske's or Bardenheuer's method of exposure; wide removal of perianal skin; free excision of ischiorectal fat; complete removal of the rectum encased in its covering of fascia propria; removal of the lowermost part of the pelvic mesocolon together with the retrorectal glands; free incision of the pelvic peritoneum and the peritoneum of the pelvic mesocolon so as to permit of several inches of the pelvic colon being drawn down; section of the bowel at or near the middle of the loop. Although this type of operation was the most extensive that it was possible to carry out from the perineum it did not suffice to reduce the recurrence rate to any appreciable extent, recurrence taking place in 94.4 per cent of the cases. Failure to prevent recurrence was due to the fact that tissues of the upward zone of spread, already invaded, lay beyond the reach of any operation carried out solely from the perineum. These tissues, representing the axilla in cases of cancer of the breast, can be approached only through the abdomen and, therefore, it is obvious that an attempt to excise the cancerous rectum from the perineum alone is as futile as amputating a breast affected by cancer without also clearing the axilla of invaded lymphatic glands.

THE RADICAL ABDOMINOPERINEAL OPERATION

As the result of my observations upon the paths by which the spread of cancer takes place from the rectum and in consequence of the failure of the most complete operation carried out from the perineum alone to prevent

recurrence, I planned the radical abdomino-perineal operation so as to embrace the tissues of the zone of upward spread in addition to those of the lateral and downward zones.

By this means the whole of the pelvic colon (with the exception of the portion to be utilized for the colostomy), together with the whole of the rectum encased in its sheath of fascia propria; the whole of the pelvic mesocolon; the peritoneum lining the floor as well as the walls of the true pelvis; the whole of the levator ani and coccygeus muscles; the external sphincter muscle; as much as possible of the ischiorectal fat and a wide area of perianal skin, are removed.

Although the operation is comprehensive in its aim, it should not be reserved for advanced cases only. It should be the procedure of choice for early cases; in fact the earlier the better because then we may hope to circumvent the invisible spread of the disease. Should it be reserved for advanced cases only, as advocated by some, then the invisible spread will have advanced beyond the confines of the operation field and recurrence will be inevitable.

The operation is a surgical procedure of the first magnitude and importance and should not be undertaken unless the patient's general condition is satisfactory. In order to ensure a successful result attention should be paid to (1) preparation of the patient before operation, (2) choice of anæsthesia, and (3) details of after treatment.

Preparation before operation. It is most important that a week or 10 days be devoted to preparatory treatment. A large number of patients suffering from cancer of the rectum also suffer from intestinal stasis, due in most instances to increasing obstruction to the evacuation of the contents of the colon. In consequence the contents of the colon are often exceedingly septic. Daily purgation and lavage not only empties the colon but reduces sepsis. In those cases in which the growth is situated at the rectosigmoidal junction, the lumen of the bowel may be so narrowed that it is not possible to wash the colon out satisfactorily. Under these circumstances, temporary cæcostomy should be performed and the radical operation postponed for a fortnight or 3 weeks. The plan which I have followed for several years past and which I have found to be very satisfactory is as follows:

1. If on examination of the abdomen there are no signs of intestinal obstruction the patient is given on the morning of admission, 1 ounce of a mixture consisting of 2 drams of magnesii sulphatis, 1 dram magnesii carbonatis, and aqua chloroformi to make 1 ounce, followed at hourly intervals by half an ounce of the same mixture until the bowels act freely. As a rule five or six doses are required. If during this treatment there should develop signs of intestinal obstruction the mixture is discontinued, ½ grain of morphia is injected hypodermically, and cæcostomy is done at once.

2. On each succeeding morning until 2 days before the radical operation 1 ounce of the mixture is given. A rectal washout of 1½ pints of plain water is administered every morning and evening and 5 grains of dimol is given twice daily as an intestinal antiseptic. The last dose of the mixture is given on the penultimate morning before the operation and the last washout on the morning before the operation, so that the intestinal canal should have complete rest for 24 hours. Several hours of sound sleep should be ensured by means of a suitable soporific.

3. During the whole of the pre-operative period the patient is kept on a generous nourishing diet until the morning of the operation.

4. The following investigations should be carried out before the operation: (1) blood examination: (a) hæmoglobin, (b) blood group, (c) blood count, and (d) blood urea. (2) urine examination: (a) 24 hourly specimen, (b) catheter specimen, and (c) urea concentration test.

Blood pressure estimation—systolic and diastolic pressures are taken while the patient is at rest in bed. I regard it of very great importance that these pressures be accurately taken in order that cardiac energy can be determined by working out the Moots-McKesson "pressure-ratio percentage." This is one of the most valuable tests of operability and should never be omitted. If the pressure-ratio is below 25 per cent the operation will be fatal and if above 75 per cent the risk to life is increased. A cardiac energy index of 50 per cent is the best possible.

A thorough examination in regard to general condition should be made, particularly of the heart and lungs.

The patient should be kept in bed during the whole of the preparatory treatment.

Choice of the anæsthetic. Ether or chloroform anæsthesia should never be employed as they produce a marked fall in blood pressure. So far as my experience goes, the best results are obtained from gas and oxygen anæsthesia supplemented by intrathecal stovain and extrathecal novocain (caudal block).

Postoperative treatment. Immediately after the operation has been completed a blood transfusion (500 cubic centimeters) should be given. There is no doubt that this is the best means of combating postoperative shock. During the past 2 years I have adopted blood transfusion as a routine measure with the result that the mortality rate has fallen to 7.6 per cent.

As soon as the patient returns from the theater the foot of the bed is raised and an electric radiant heat cradle is fitted over him, the temperature being carefully regulated.

Continuous subcutaneous saline is administered during the first 24 hours.

The amount of fluid administered by the mouth must be strictly limited so as to lessen the risk of acute gastric dilatation. Careful watch for the onset of this complication should always be kept and as soon as the subxyphoid depression becomes effaced the stomach should be emptied by passing the stomach tube.

The perineal wound is dressed for the first time 48 hours after the operation. After the gauze packing is removed, the cavity is irrigated with (1) hydrogen peroxide (10 vols.) 1 pint, followed by (2) perchloride of mercury (1:500) 1 pint, followed by (3) 2 pints of normal saline solution. Irrigation with these solutions is carried out twice daily during the first week, after which period a solution of iodine (2 drams to the pint) is substituted.

On the morning of the fifth day an enema is administered by the colostomy and on the following day a saline purgative is given. The colostomy washout is repeated daily.

At the end of a week the excess of bowel, forming the colostomy, is removed. Digital dilatation of the colostomy stoma is carried out daily until the tendency to contract, during the healing process, has ceased.

Operability rate of the abdominoperineal operation. As might be expected, a larger proportion of cases are operable by the abdominoperineal route than is possible by perineal methods of excision. This is largely due to the fact that high lying growths, at or near the rectosigmoidal junction, are considered to be out of reach by an operation undertaken from the perineum alone. I find that, after excluding not only the cases in which the local disease is too far advanced but those, at any stage of the disease, in which age, general condition, or low cardiac energy index, indicate bad operation risks, the operability rate among the cases that come under my observation is exactly 32 per cent.

Recurrence rate of the abdominoperineal operation. Having now performed close upon 400 radical abdominoperineal operations I am able to state quite definitely that, as compared with perineal methods of excision, the number of recurrences is exceedingly small. For the purpose of the following statistics I have taken the survivals of operations performed during the period 1920 and 1925 so that every one of the patients, who are now alive, have passed the five year limit. Also I have worked out the statistics for each of the varieties of rectal cancer because they differ considerably in degree of malignancy.

Variety of cancer	Survivals	Untraced	Died other causes	Died of recurrence	Alive and well	Recurrence rate per cent
a. Papilliferous	11	1	2	0	10	0
b. Adenoid	73	7	6	9	58	11
c. Colloid	8	0	0	7	1	87.5
d. Melanotic	2	0	0	2	0	100

From these statistics it appears that cases of colloid and melanotic carcinoma are not worth operating upon when the histological appearances are known beforehand, and that the recurrence rate for all varieties is only 28 per cent, which is encouragingly low.

SURGICAL TREATMENT OF NEUROGENIC CONTRACTURES[1]

PROFESSOR OTFRIED FOERSTER, BRESLAU, GERMANY

CONTRACTURE is fixation of a limb. We call the contracture neurogenic if fixation is brought about by contraction of a muscle or a muscle group as the result of abnormal innervation. Such pathological innervation of muscles may be the result of several different factors, some of which are briefly discussed.

Contracture caused by pathological irritation of peripheral motor nerve fibers. A well known example of this type of contracture is tetany, an example of which is shown in Figure 1. This type rarely occurs following traumatic nerve lesions. In the case shown in Figure 1, besides the contracture of the interosseous and the hypothenar muscles, a markedly increased excitability of the ulnar nerve in response to mechanical and electrical stimuli was noticed. The same lowered threshold was observed in other nerves, for instance, the facial. At operation, which was performed inasmuch as the contracture was permanent, it was found that the nerve was adherent to the neighboring structures and that a small piece of bone was embedded in the nerve trunk. Removal of the piece of bone and liberation of the nerve from its adhesions caused the contracture to disappear completely. I have observed a small number of similar cases with permanent tonic contractures of the muscles, the motor nerve supply of which had been traumatized. In all of them there was found the same increased excitability of the traumatized nerve as well as of other nerves to mechanical and electrical stimuli, so that I believe all of them were the result of latent tetanies. The irritation of one single nerve by the traumatic process became effective only if there was present a latent tetanic condition. On the other hand the contracture disappeared promptly when the scar tissue surrounding the nerve or the foreign body embedded in the nerve was removed.

Contractures produced by pathological irritation of afferent peripheral nerve fibers. Reflex contractures due to irritation of the sensory fibers of a peripheral nerve are very common. They develop following the division of a cutaneous nerve and the formation of a neuroma at the central stump, or they are the result of the nerve being embedded in scar tissue. Pain is a constant symptom following the permanent irritation of the sensory nerve fibers in reflex contracture cases. These contractures are produced in such a way that the injured nerve is relaxed and thus the degree of irritation is diminished. Passive and active movements in the opposite direction, which would stretch the nerve and therefore increase the irritation, are either impossible or at least markedly reduced. Figure 2 illustrates the condition found in this group.

The reflex origin of all such contractures can be demonstrated by injecting novocain proximal to the lesion. Permanent relief has been obtained in the majority of the patients only by avulsion of the injured nerve. Simple liberation of the nerve does not give good results since the nerve later becomes again adherent to the surrounding scar tissue.

Reflex contractures due to pathological irritation of afferent nerve fibers occur also in traumatic lesions of mixed nerve trunks. The surgical procedure in these cases is either excision of the neuroma, followed by suture if the nerve is divided, or, in less severe cases in which the motor fibers of the nerve are only slightly damaged or not damaged at all, liberation of the fascicles of the nerve trunk (endoneural neurolysis). Simple liberation of the nerve trunk is not sufficient, for recurrence often occurs.

Reflex contractures following pyramidal tract lesions. Contractures following pyramidal tract lesions are also reflex in their origin. The increased reflex activity, however, is not the sequel of a permanent pathological irritation of the afferent nerve fibers but of the loss of control, of inhibition, exerted under normal conditions, by the motor cortex upon the spinal reflex arcs. The spastic contracture in pyramidal tract lesions is nothing but the

[1] Presented before the Clinical Congress of the American College of Surgeons, Philadelphia, October 13–17, 1930.

increased muscular reflex response to stretch (stretch reflex). The limbs are fixed by the stretch reflex, passive movements are reduced or even impossible. In these cases the reduction of active movements also depends at least to some extent, upon the resistance of the stretched antagonist to the movement.

Due to the abnormal reflex activity of the spinal cord, the limbs are often brought into abnormal positions and then fixed in these positions by the stretch reflex. Examples are the flexor contracture of the legs in some cases of spastic paraplegia; the adductor contractures, the legs being crossed in other cases of spastic paraplegia; the contracture of the flexors of the forearm, of the flexors and pronators of the wrist, and of the flexors of the fingers in spastic paralysis of the upper extremity.

There are three ways to relieve the increased response of the muscle to stretch:

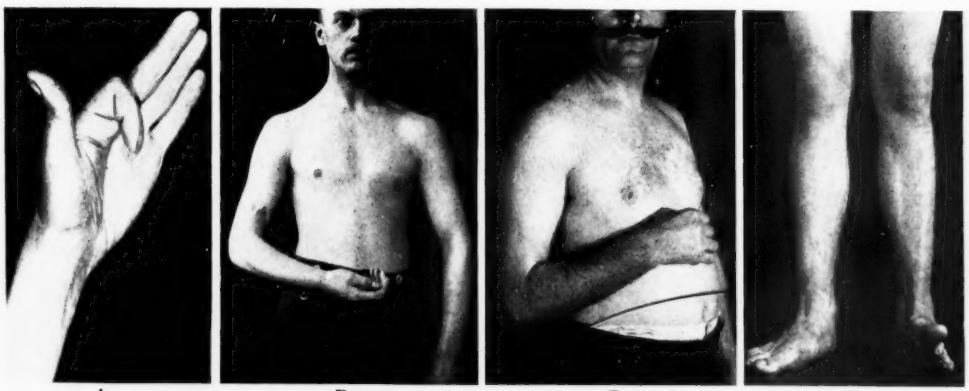
1. Operations on the muscles and tendons: (a) complete cutting of the tendon or of the muscle, certainly a radical procedure and permissible only, if the muscle is dispensable; (b) lengthening of the tendon of the spastic muscle, for instance, of the Achilles tendon; (c) transplantation of one point of insertion of the muscle to a point closer to the other point of insertion, especially advised for muscles overbridging two or more articulations, for instance, transplantation of the upper insertion of the hamstrings from the tuber to the posterior surface of the femur.

Fig. 1. Typical tetaniform contracture in a case of traumatic lesion of the ulnar nerve.

2. Total or subtotal deefferentation of the spastic muscle by total or subtotal resection of its motor nerve branches. The total deefferentation of a muscle is certainly permissible only if the muscle is dispensable. Subtotal deefferentation also weakens the motor power of the muscle and therefore is a two edged sword, however effective.

3. Deafferentation of the spastic muscle by resection of the posterior spinal roots.

A fourth procedure, resection of the rami of the sympathetic chain to the spinal nerves



A B C D

Fig. 2A. Contracture of the flexor sublimis of the index finger due to scar tissue in which the proper volar digital nerve of the index finger was adherent.

Fig. 2B. Flexor contracture of the forearm, due to the traumatic scar, in which the lateral antibrachial cutaneous nerve was embedded.

Fig. 2C. Flexor contracture of the forearm; the hand is pronated. The dorsal antibrachial cutaneous nerve was adherent to a scar at the upper third of the forearm. Note the marked hypertrichosis on the forearm due to the permanent irritation of the nerve.

Fig. 2D. A very frequent type of contracture of the foot in supination, observed usually after injury of the plantar nerves or of the tibial nerve in the lower third of the thigh.

Fig. 3. Fig. 4A.

Fig. 3. Inability to dorsiflex foot in spastic hemiplegia.
Fig. 4A. Marked supination of foot in case of active dorsiflexion in spastic hemiplegia.

of the spastic muscles, might be mentioned. It is based upon the idea that a spastic contracture is an increased muscle tone and that muscle tone is due to the sympathetic innervation of the striped muscle. I do not believe that this theory has sufficient physiological basis, and therefore, the method need not be taken into consideration.

Fig. 6A. Fig. 6B.

Fig. 6A. Flexion of foot after operation.
Fig. 6B. Flexion of the foot in straight direction.

Fig. 4B. Fig. 5.

Fig. 4B. Only the external border of the foot is placed on the ground.
Fig. 5. The toes really grasp into the ground.

I cannot enter into a detailed discussion of the different procedures for the relief of spasticity in pyramidal tract lesions. I should like, however, to demonstrate briefly, the procedure I personally use in the different types of spastic paralysis.

In the presence of a hemiplegia the spasticity involves, as far as the leg is concerned, chiefly the calf muscle and the extensors of the tibia (quadriceps). Active dorsiflexion of the foot is impossible or reduced, a condition best seen when the paralyzed leg is brought forward in walking (Fig. 3). If active dorsiflexion of the foot is possible, the foot does not go up in a straight direction but undergoes a more or less marked supination (Fig. 4A). In walking, therefore, only the external border of the sole of the foot is placed upon the ground (Fig. 4B). Very often the flexors of the toes contract markedly the very moment the foot touches the ground; the toes really grasp into the ground (Fig. 5), which is often very painful for the patient. Due to the spastic contracture of the extensors of the knee, the leg cannot be flexed so that in walking the knee is held stiffly in a more or less completely extended position (Fig. 3).

To overcome the spastic contracture of the calf muscles, the lengthening of the Achilles tendon to a sufficient degree is the best procedure. To overcome the supination, which

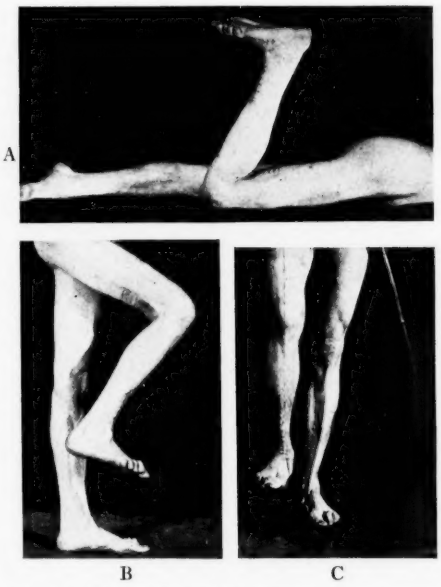


Fig. 7A. Flexion of leg after operation.
Figs. 7B and 7C. Result after entire series of operations. The paralyzed leg is well flexed and the foot is dorsiflexed in a straight line.

the foot undergoes if flexed, I either resect the motor branches of the posterior tibial muscle or lengthen its tendon behind the internal malleolus. Also, I split the tendon of the anterior tibial muscle into halves longitudinally and insert one-half into the tendon of the peroneus tertius. After this procedure the foot can be flexed to a large extent (Fig. 6A), and it is raised in a straight direction (Fig. 6B). The picture shows that the transplanted part of the tendon of the anterior tibial muscle forms a prominence under the skin. To prevent contraction of the flexors of the toes, which occurs when the foot comes in contact with the ground, the best treatment is total subcutaneous tenotomy of the tendons of the flexors of the toes, just proximal to the point where they reach the toes. I cut the tendons one by one.

To overcome spastic contracture of the quadriceps the best procedure is partial resection of the crural nerve just below the inguinal fold. I usually divide one-half of each of the bundles which the nerve forms at that region, after having carefully separated from the nerve trunk the

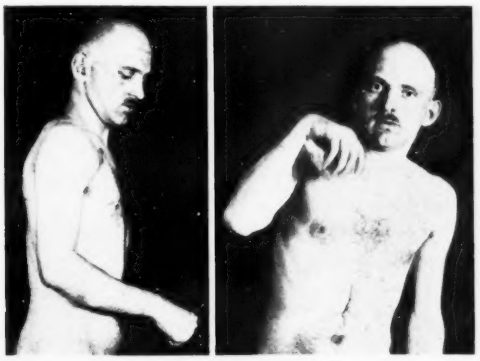
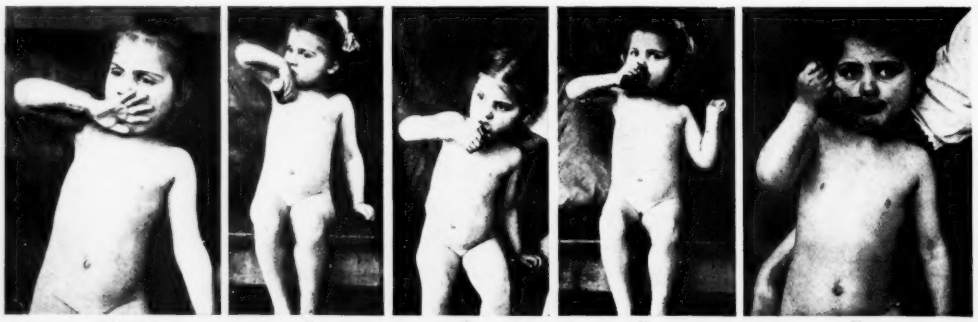


Fig. 8A. Contracture of the arm in hemiplegia.
Fig. 8B. Full extent of movement possible.

Fig. 9A. Patient after deefferentation of the adductors of the humerus showing how well the arm can be elevated.
Fig. 9B. The forearm can be well extended after partial resection of the musculocutaneous; fingers are extended after partial resection of the nerve branches of the flexors of the fingers.
Fig. 9C. By this resection the motor power of the flexors of the fingers was weakened so little that the fingers could be flexed firmly, so that grasp is possible. The wrist is not completely extended in this case, when the hand is closed, since I had not transplanted the tendons of the flexors of the wrist to the extensors; only tenotomy of the flexors of the hand was done. However, that the result obtained is satisfactory, becomes evident, when we compare it to the condition before the operation (Fig. 8B). In other cases the wrist can be extended completely after tenotomy of the flexors of the hand.



A B C D E

Fig. 10A. A girl with infantile hemiplegia. She could not use her right hand to eat and drink. The most striking detail of the motor disturbance in her case was the extensive pronation of the hand, occurring each time she brought the hand to the mouth; the palmar surface of the hand was really turned away from the mouth.

Fig. 10B. Flexion of the wrist when the girl held a glass with her fingers and tried to drink.

Fig. 10C. The result obtained by total deefferentation of the pronator teres and tenotomy of the flexor carpi radialis and ulnaris. The palmar surface of the hand is well turned toward the mouth and the wrist is extended. But there was left still another disturbance, very frequent in infantile hemiplegia; the hand, when extended, deviates to its ulnar border. Therefore, in trying to drink, the edge of the glass does not reach the lips in a correct manner.

Figs. 10D and 10E. Result of operation showing that the girl is able to bring the glass in a correct way to the mouth and in a like manner a spoon. The ulnar extensor of the wrist was transplanted to the long radial extensor.

bundles of the anterior cutaneous and of the internal saphenus nerves. I do the resection gradually, examining carefully the knee jerk each time a single bundle is cut. The knee jerk serves as an index of the number of fibers to be divided. The reflex must by no means be lost. After this procedure the leg can easily be flexed (Fig. 7A).

Figures 7B and 7C show the patient walking after the entire series of operations; the paralyzed leg is well flexed, the foot is well dorsiflexed in a straight line.

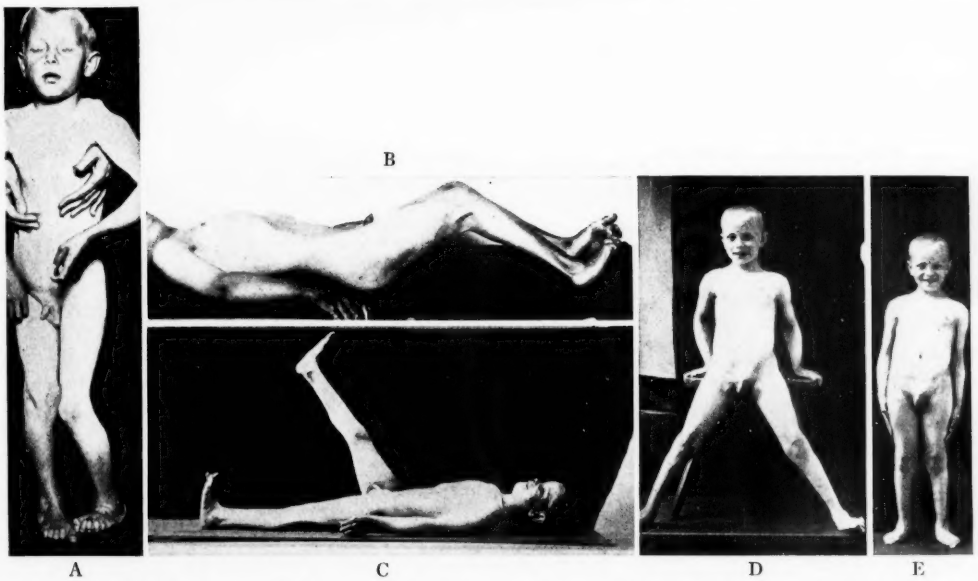
I have performed this operation in nearly 100 cases, most of which were spastic hemiplegias following traumatic lesions of the brain. Nearly all of the patients have been benefited.

If necessary, spastic contracture of the adductors of the femur can easily be overcome by subtotal resection of the obturator nerve in the pelvis through the extraperitoneal approach.

In infantile hemiplegia there is often a retraction of the hamstrings. In these cases I lengthen the tendons of the hamstrings by a special method.

The results of the surgical treatment of the spastic contractures of the paralyzed upper extremity in pyramidal tract lesions are not so good as are those in the leg. However, in some cases good results can be obtained. In the arm the spasticity involves chiefly the adductors and internal rotators of the humerus, the flexors of the forearm, the pronators and flexors of the fingers, and the flexor and adductor of the thumb (Fig. 8A). If voluntary movement is possible to a certain degree, nearly always the only possible movement is a typical combined synergia; isolated movements of the single segments of the upper extremity cannot be performed. This synergia consists of an abduction of the humerus usually very limited by the spasticity of the adductors, a flexion of the elbow, a pronation and flexion of the hand, and a flexion or extension of all fingers together. In such a case the patient is not able to bring an object, for example a glass, to his mouth (Fig. 8B).

To overcome spastic contracture of the adductors I resect some of the motor branches of the pectoralis major and the motor nerve of the latissimus and teres major. To overcome spasticity of the internal rotators of the humerus I resect the majority of the nerves of the subscapularis. For contracture of the flexors of the forearm I resect one-third to one-half of the musculocutaneous nerve; for contracture of the pronators of the hand the



A B C D E

Fig. 11A. Boy with severe congenital spastic paraplegia.
Fig. 11B. Voluntary motility was greatly reduced. He could walk with help but the gait was very spastic, the legs were fixed against each other and he had much trouble in moving them forward.

Figs. 11C and 11D. After root resection the voluntary movements became perfect.
Fig. 11E. The boy now stands alone.

motor branches of the pronator teres. For contracture of the flexors of the wrist I cut the tendons of the flexor carpi radialis and ulnaris and sometimes I insert these tendons into the tendons of the extensors of the wrist. The overcoming of contracture of the flexors of the fingers is a very difficult problem. In several cases I have resected some of the motor fibers of the flexor sublimis and profundus and of the flexor pollicis longus. This is a long and delicate procedure; for while a sufficient number of fibers must be cut to relieve the spasticity,

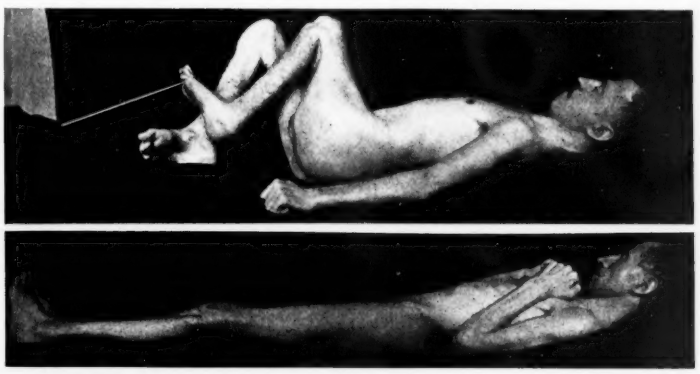


Fig. 12A, above. Flexor contractures in disseminated sclerosis or compression of the cord.
Fig. 12B. Improvement after posterior root resection.

Fig. 13. Photographs of 2 patients with wry neck taken before and after operation.

it must be remembered that enough fibers should be left so that the motor power of the fingers flexors will not be too greatly reduced. For contracture of the adductor of the thumb the best treatment is tenotomy of the adductor. Figures 9 and 10 demonstrate the results in 2 cases.

Posterior root resection is advisable to relieve paraplegia with more or less generalized contractures. How far voluntary motility can be restored by this procedure, depends upon the number of innervating fibers of the corticospinal pathways, which are preserved (Fig. 11). If they are all interrupted, spasticity is removed by the resection of the posterior roots, but paralysis persists; the palsy becomes flaccid.

In the treatment of congenital spastic conditions, one point must be stressed. Root resection is suitable only for pyramidal tract lesions but not for the striatal processes, the clinical picture of which is often similar to that of the pure pyramidal tract syndrome. I believe that many failures in the result after posterior root resection are due to the fact that proper selection of cases has not been practiced. Also, the child should have sufficient intelligence so that he can co-operate in a systematic regimen of exercise after operation. It would be impossible to secure a good result in a feeble-minded child. Patients who have epileptic fits should not be operated upon by root section.

Also in adults posterior root resection may be advisable in severe cases of spastic paraplegia.

As we all know, spastic paraplegia with contracture of the flexors and highly increased flexor reflexes is a most deplorable condition. It is found in the presence of severe traumatic cord lesions, in the presence of advanced compression of the cord, in the presence of intramedullary tumors, and especially in the presence of advanced disseminated sclerosis. The patients suffer severely from the contractures and the permanent flexor spasms. Figure 12 is an example of such a condition. In these cases resection of the posterior roots gives much relief. The contractures are more or less relieved and the flexor reflexes are abolished or much reduced. Voluntary motility practically never returns, since the motor cortical pathways are totally or almost totally interrupted.

Although in pyramidal tract lesions the increased stretch reflex of the muscles, that is spasticity, is abolished by root resection, in the pallidal syndrome, the parkinsonian states, root resection is not advisable. The stretch reflex is abolished by the procedure, but not the contracture, the muscles still receiving their abnormal innervation from the midbrain. Division of the spinal anterolateral tract also does not offer much relief. Until recently I could see no way of relieving these conditions by surgical procedures.

In concluding my paper I will describe the surgical procedure for relief of spastic torticollis. Torticollis is caused by a cramp of the contralateral sternocleidomastoid and the prosolateral neck muscles. Therefore I cut the contralateral accessory spinal nerve and the homolateral upper cervical roots (first to fourth) anterior and posterior roots, intradurally. Figure 13 shows two of my cases of wry neck before and after the operation.

CONTRACTURES OF THE HAND[1]

SUMNER L. KOCH, M.D., F.A.C.S., CHICAGO
From the Department of Surgery, Northwestern University Medical School

IN discussing the subject of contractures of the hand I wish at the outset to make it clear that I can claim but little credit for the work that has been done and the results that have been accomplished. The major share of that credit belongs to Dr. Kanavel, and to the various men who have been associated with him from time to time; and among them, particularly, Dr. Michael Mason. It is scarcely necessary to add that our group owes a great deal to the outstanding work that has been done by other surgeons working in this and in related fields. Blair of St. Louis and Davis of Baltimore, particularly, have taught us how to transplant skin and subcutaneous tissue safely. Mayer of New York and Bunnell of San Francisco have contributed much to the surgery of the tendons; the entire group of orthopedic surgeons of our own country and others have contributed to the surgical treatment of tendon fixation and ankylosed joints. We have adopted their ideas freely and tried to utilize them in the treatment of contractures of the hand.

Acquired contractures of the hand may be due to many causes, but by far the most important are infection and injury. It is this group of cases which we wish to discuss this evening.

Of first importance is the question of prevention. Contractures result from scar tissue formation. Scar tissue is formed after normal tissue has been destroyed; for example, after a burn, or a crushing injury. It is formed as a diffuse inflammatory process, such as a cellulitis of the hand or a tendon sheath infection, subsides; it is formed if only tissues which normally are subject to free and constant movement are kept immobilized for more than three or four days. Familiar examples are the fibrosis that develops in fingers which are fixed in extension because of a fractured phalanx or metacarpal, or the fibrosis that develops—perhaps not quite so promptly—about any joint which is immobilized because of a fracture in its vicinity.

With these causes of fibrosis and scar tissue formation in mind we may formulate a few principles of importance in prevention: first, not to wait for large raw surfaces, which result from burns and crushing injuries, to heal spontaneously. If such surfaces are covered at the earliest possible moment with skin grafts time is saved for the patient, the constant danger of reinfection is eliminated and the formation of scar tissue is reduced to a minimum. A second important principle in prevention, and one which can scarcely be

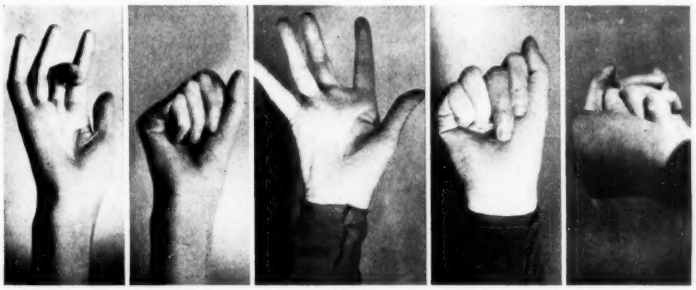
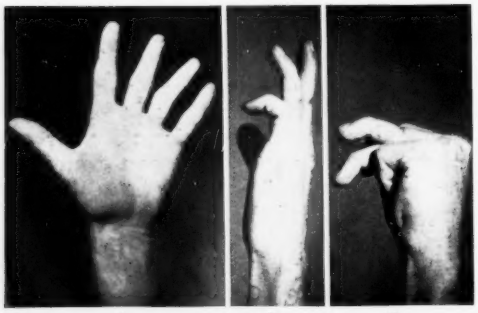


Fig. 1. Result of tendon transplantation following loss of flexor tendons of middle finger secondary to a suppurative tenosynovitis. A, B. Limit of extension and flexion before operation (flexion is accomplished by contraction of the intact lumbrical muscle). C, D, E. Extension and flexion possible after operation.

[1]Presented before the Clinical Congress of the American College of Surgeons, Philadelphia, October 13-17, 1930. Because of lack of space this Paper is published in abstract only. The complete paper will appear in a later number.

overemphasized, is early mobilization. If fibrosis can develop after simple fractures when no infection is present, it is obvious that the presence of an inflammatory exudate hastens and accentuates the process, and that in the treatment of a hand infection early mobilization is an important feature of adequate surgical care if contractures are to be prevented.

When contractures have already developed, the treatment varies with the anatomical structures involved. There may be involvement of skin and subcutaneous tissue only; there may be involvement of tendons alone; there may be involvement of the median and ulnar nerve; there may be involvement of joints of fingers, hand or wrist; finally there may be involvement of several or all of these structures, and these complicated cases with injury and fibrosis of covering tissues, tendons, nerves and joints are of all the most trying and most difficult.



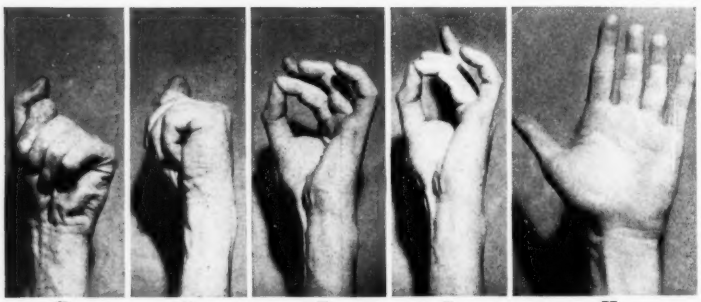
A B C

For contractures due to loss of skin and subcutaneous tissue we have invariably resorted to some form of skin grafting to replace the lost tissue. For contractures of the palm, as a result of our own experience and that of others we have come to use in the majority of cases the free full thickness graft. For contractures due to firm scar tissue between the thumb and index finger and contractures involving the dorsum of the hand alone the tubed flap affords a very satisfactory method of securing a covering of normal tissue. For contractures involving the dorsum of fingers as well as the hand a pocket flap on abdomen or thigh is useful.

Because of the limited time at my disposal I can present in this spoken discussion but two cases illustrative of the second and third groups of contracture—those in which fibrosis or loss of tendons is the essential factor, and those in which joint fixation is the essential factor.

This patient (Fig. 1) sustained a loss of the flexor tendons of the right middle finger secondary to a suppurative tenosynovitis. As healing took place the finger contracted until it was fixed at approximately a right angle. Six months after healing was complete the scar tissue and remains of the fibrous tendon sheath were excised and two tendons from the foot transplanted to the finger to replace the lost tendons. Before operation the finger could be flexed into the palm with the aid of the lumbrical muscle, but it could not be extended and no movement was possible at the interphalangeal joints. After operation the finger could be extended almost completely and flexion was restored almost to normal.

This patient (Fig. 2), a teacher of manual training and a violinist, sustained a saw cut across the dor-



D E F G H

Fig. 2. Arthroplasty for bony ankylosis at the proximal interphalangeal joints of the middle and ring fingers. A, B, C. Before operation. D, E, F, G, H. Result after operation.

sum of his middle and ring fingers which resulted in a bony ankylosis at the proximal interphalangeal joints of these fingers. An arthroplasty was performed by excising through a lateral incision a section from the head of the proximal phalanx of each finger and filling the new joint cavity with a free transplant of fat from the abdominal wall. Six months after operation he was able to extend his fingers to a straight line and flex them to the palm.

The fourth group of contractures—those due to injuries of the peripheral nerves in or near the hand may well be included with the fifth and last group—the complicated contractures—for injuries of the nerves alone are relatively uncommon; they are almost always associated with injuries of the tendons.

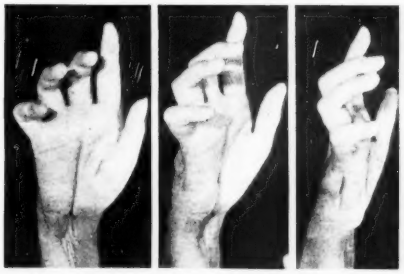
The fifth, the last and most difficult group of cases, the complicated cases, are usually the result of one of five types of injury. These are (1) burns from fire, gas or gasoline explosions, high voltage currents or repeated X-ray exposures; (2) trivial injuries which result in severe and spreading infection; (3) glass cuts, which frequently result from automobile accidents and most commonly cause a laceration or division of the flexor tendons and of the median and ulnar nerves at the wrist; (4) crushing injuries, and (5) gunshot wounds. A few specific cases help to illustrate some of the possibilities of treatment in these conditions.

This patient (Fig. 3), a nurse, sustained a severe spreading infection of the right hand and forearm following a penetrating needle wound of the thenar eminence. As a result of the infection, and the pressure necrosis resulting from drainage tubes left in position for a long period of time, the flexor tendons were destroyed from the level of the metacarpophalangeal joints to a line 2 inches above the wrist. The median nerve was completely divided just above the wrist joint. A bony ankylosis had developed at the wrist joint. The appearance of the hand before operation is shown here.

August 30, 1927, four and one-half months after the hand was healed, tendons from the right foot were transplanted to the hand and forearm and the median nerve ends united by end-to-end suture. A severe postoperative infection developed, we believe because we had not waited long enough for the virulent bacteria to disappear from the tissues; and as a result of this infection all the transplanted tendons except that to the thumb were lost.

November 1, 1928, an arthroplasty was performed at the wrist joint and because no febrile reaction developed after operation the tendon grafting was repeated February 2, 1929. The result in January, 1930, is shown in Figure 3. Restoration of sensation in the median nerve area had taken place in spite of the infection following the first operation.

This patient (Fig. 4), a boy of thirteen years, sustained a glass cut across the volar surface of the right wrist in an automobile accident May 26, 1929. The wound bled profusely so that he sustained a rather alarming hæmorrhage. He was taken to a hospital immediately and the wound repaired. He was told that some tendons and nerves and the ulnar artery had been divided and repaired. The wound healed without infection, but in spite of physical therapy begun immediately after discharge from the



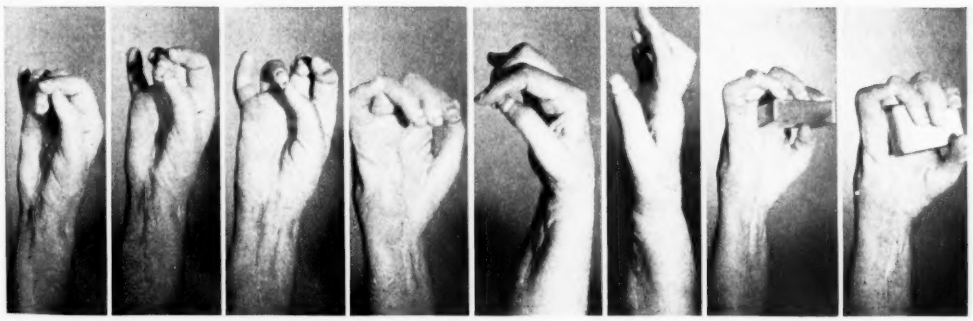


Fig. 3. Loss of flexor tendons and erosion—division of median nerve. Upper row—before operation. Lower row—after nerve suture, arthroplasty, and tendon transplantation.

A B C D E F

Fig. 4. Division of flexor tendons, median and ulnar nerves. A, B. Before operation. C, D, E, F. Result 14 months after operation.

hospital the fingers remained motionless in extension and the hand numb.

At operation July 22, 1929, the divided tendons, median and ulnar nerves were found imbedded in a mass of scar tissue. The proximal segment of the median nerve had been joined to the distal segment of the superficial flexor to the ring finger. The ulnar nerve ends were united by fibrous tissue. The nerves and tendons were carefully freed and united in an anatomical arrangement. The result February, 1930, is shown in Figure 4, C, D, E, F.

Complicated cases, such as these, frequently require multiple operations. It may be necessary first of all to substitute a covering of normal tissue for the dense superficial scar which limits the mobility of structures whose very function depends on freedom of movement. Joints which have become ankylosed must be freed. Tendons which are bound together by scar tissue must be released; tendons which are destroyed replaced, nerves which control motor and sensory and trophic function must be released from scar tissue which strangles them; if they have been divided they must be sutured end-to-end.

Along with these operative procedures well directed and skillfully applied physical therapy and the use of properly designed splints which bring elastic tension to bear on contracted tendons and stiffened joints are important factors in securing a successful result.

TREATMENT OF COMPOUND INJURIES[1]

FREDERIC J. COTTON, M.D., F.A.C.S., BOSTON, MASSACHUSETTS

COMPOUND injuries are of necessity very serious injuries. The problem of caring for the injured bone alone is a difficult one but there is usually present in addition lacerated or crushed soft tissue which must be dealt with. Even in clean cases there is always the likelihood of infection, and when infection occurs it renders the mechanical handling of the fracture difficult and often ineffective.

During the Civil War period all compound fractures were marked for amputation. Times have changed, however, for today we amputate only when we know that we cannot give the patient a comfortable, useful limb and when we know that the life of the patient is endangered. In injuries about the feet, ankles, and lower legs, as in crushing injuries of the elbow, it is better to attempt to secure healing without too much surgery. Later if necessary an arthroplasty can be done. Broadly speaking, therefore, our object should be to secure for the patient a useful limb.

There are several vital problems to be considered in the treatment of compound injuries and of first importance is the matter of infection. Infection almost always comes from without, that is, it may be carried into the wound from the soil through contact with the wound at the time of injury; from pieces of clothing driven into the soft tissues; from the skin; or from some unknown source during operation.

The staphylococcus may be carried into the wound from the patient's own skin or clothing. The streptococcus which is commonly present in the tonsils is probably the only bacterium which is apt to enter the wound by way of the air or through contamination during operation. However, air borne infection is probably so rare as to be negligible, provided masks are worn in the operating room.

Tetanus infection, of course, is rare in some communities but not uncommon in others, as for instance in some farming districts or in rural districts settled for some time. Tetanus is rare in Boston so that when we have a case on our service we are apt to call on some one at the Massachusetts General Hospital for counsel, since they have to deal with such cases from the country districts and understand the treatment. As to the use of antitetanic serum it is questionable whether it should be considered a routine measure. In a tetanus district I believe that it should be given. I still use it in my hospital service but do not always use it in my private practice. To be effective not only the initial dose of 1,500 units should be given but to avoid anaphylaxis the dose should be repeated at intervals of a week. I have seen a fatal outcome 6 weeks after a patient had received the initial dose only, and I have seen many nasty reactions after its use.

Gas bacillus infection, known also as malignant œdema, gas gangrene, and vibrion septique infection, is another dread complication. Like tetanus it is more often found in the agricultural districts but it is not unusual in cities. There are two types of gas bacillus infection, both producing the bacillus welchii in culture. The most deadly type, with which we became familiar during the War, destroys muscle. The other type is more mild. It produces quiet bubbles and the pathognomonic smell in its course through the subcutaneous fat. In some instances even of this milder type the outcome is fatal. Invariably in all cases there is an aftermath of slough and secondary infection. In treating gas bacillus infection we use a precautionary dose of both antitetanus and bacillus welchii serum, but we believe that surgical débridement is an essential step in the treatment of all infected wounds and that in addition to the thorough débridement a stream of oxygen should be constantly played into the wound through Dakin tubes.

The staphylococcus infection is one which we fear, for not only does it cause great destruction of tissues but the patient's life is endangered.

[1]Presented before the Clinical Congress of the American College of Surgeons, Philadelphia, October 13-17, 1930.

TREATMENT

The practical question is what should the routine course of treatment be. Formerly the Treves method, not uncommonly used today, was followed: in small wounds leading to fractures the surface was cleansed, a sterile dressing or aristol was applied, and the wound was left to heal. The results were not uniformly bad but I never felt that such treatment was adequate. The logical thing to do is to class all compound fractures as infected and then to open up the wound, clean it, fix the fracture, and close the wound not too tightly. I remember no punctate wound that became septic after real cleaning, but I can recall several not cleaned that became septic. Débridement, unless properly done, may lead to disastrous results. It would seem best to open up widely, inspect the wound thoroughly, clean out doubtful tissue, wash and trim the wound again, being careful not to injure vessels and nerves.

The wound should be closed but not too tightly. We should always bear in mind that a hæmatoma is ideal culture ground for infection. During the War I traced the trouble in one of our Clearing Stations to the fact that too fine seamstress work had been done in closing wounds, in many instances the wounds being sealed tight. If the wound is a gaping one and the edges cannot be approximated without too much tension, a cut should be made more or less parallel to the edges of the wound and two or three inches distant and the flap thus made should be slid over until the wound can be comfortably covered. The secondary wound gives no trouble. Our rule should therefore be to cover the wound with outlet for drainage and without tension.

No rules, of course, should be laid down as to the dressings. The massive Western cotton-batting dressing for moderate, even, pressure helps. Protective splinting should of course be used.

The fracture should be reduced so far as possible. There is every reason *for* and not *against* skeletal or other traction, applied promptly as needed, or for fixation by plaster or splints. Proper immobilization is some guarantee against sepsis.

Any method of reduction and fixation by means of foreign material in the wound is risky. If one uses such methods he should go the whole way, and as William O'Neill Sherman does, deal with a putative infection by using Dakin irrigation. By and large, most of us, less well situated than Sherman, will sacrifice something of what we might wish to do in favor of clean handling, and hope to do our mechanical repair work later if need be. This sounds like a bit of cowardly advice, but the fact is, that, for diverse reasons, no big metropolitan hospital I happen to know is in a position to do the *ideal* thing as a routine.

Our practice therefore should be to reduce as we can, close with all precaution, and await events. If no infection develops, the problem becomes one of reconstruction surgery, if this is needed; later, an osteotomy, an arthroplasty, whatever is called for.

If infection ensues, what then? Of course, I know none of you has ever had a case go wrong, but sometimes they do.

On my service—the bone and joint service at the Boston City Hospital—we have admitted to us a few already septic compound fractures. Some of them resemble those that came back in 1918–1919. It is only recently that we have seemed to secure satisfactory results.

Back in the postwar period I devised a perforated steel cylinder to cover about a third of the circle into which rambling ends of the femur, or other bone, might be sutured and held, without interfering with the Dakin treatment. It was of distinct help in a number of cases which could not otherwise have been protected against gross deformity. Later I brought from Chicago to Boston the "Smith" clamp. Not even today do I know *which* Smith produced this clamp, which has harmless, blunt arms, which are set home with cam locks. This clamp has been of much service at the Boston City Hospital.

Dr. Otto J. Hermann, subchief of my service, is working on the problem of treating septic compound injuries, and he has secured some satisfactory results. He not only fixes the fracture by open operation but institutes effective drainage. His method of channeling for drainage, so far as I know, is entirely new. Briefly he proceeds as follows: He channels a trough in each bone end, entering the medul-

lary space; so far as possible he thoroughly sterilizes the scrubbed out field with carbolic acid (96 per cent), washing out the excess with alcohol; he then reduces the fracture and maintains the reduction with the Smith clamp, which, be it noted, *pierces* no tissue, and holds with a minimum of pressure.

I have seen Dr. Hermann's work and I believe that the method is of great value in salvaging the definitely infected compound fractures which are brought to our municipal hospital.

I will cite briefly the histories of a few cases:

CASE 1. M. N., aged 6 years, 1925. Patient suffered a compound fracture of the left lower leg as the result of a hot water radiator falling on him. He was treated at the Massachusetts General Hospital, where the wound was débrided and sterilized; but no attempt was made to reduce the fracture. The wound became septic in 3 weeks, and was incised. Patient was transferred to the City Hospital. The incision was enlarged, the fracture reduced, a trough was chiselled in the fragment ends, to allow good drainage, the wound was sterilized, a Smith clamp was applied, and Dakin tubes were laid in. Convalescence was remarkably good. Small sequestra came out, but no further operation was necessary. The clamp was removed at 6 weeks. Union had taken place at 3 months, and position was excellent. There had been no recurrence of sepsis in the 5 years since.

CASE 2. G. P., aged 34 years, 1928. Patient was admitted to the City Hospital with a comminuted compound fracture of both bones of the lower leg and much laceration to soft tissues. The wound was already infected. An attempt had been made to clean up the wound, but the fractured bones were overriding, and sepsis seemed to be progressive. It really seemed to be a case for amputation. The patient was transferred to our service. We decided not to amputate but to clean up the wound, channel, and fix the fragments. This Dr. Hermann did. Several fragments of bone sloughed out. The tibia eventually united at 3 months, and the sepsis cleared up with final healing in 6 months. The patient went back to work in 9 months with a solid leg. He is now working as a railroad express foreman, and is on his feet 10 to 12 hours a day.

CASE 3. G. H., aged 26 years. Patient entered the hospital February 11, 1930. He had a compound, comminuted fracture of both bones of the lower leg, the result of an automobile accident. He was given the routine treatment on another service, but there was violent sepsis and total loss of position. He was transferred to our service, and Dr. Hermann treated him in the usual way, except that in trimming to get approximation it was necessary to sacrifice a bit of bone. A Smith clamp was applied, and Dakin tubes were inserted. The clamp was removed at 10 weeks; active sepsis cleared in 3 months. Union was slow but complete in 5 months. Patient is now walking, but is still using a supporting caliper, as the diameter of the new bone is below the normal.

We have recently treated a few cases with the Orr vaseline technique instead of the Dakin technique but it is too early to report on the results.

Occasionally, in spite of our best efforts, cases go on to some degree of osteomyelitis. With rare exceptions the osteomyelitis is a limited process and results in what are described as "ferrule" sequestra—ring-shaped sequestra about each bone end. The sequestra loosen at about 8 weeks, are removed, and then, if by traction or clamps we maintain position, union takes place, slowly, of course, and not so much by external callus as by endosteal repair from the living marrow ends.

One big problem confronts us in cases with extensive loss of bone and that is whether to shorten the limb or allow it to shorten, or the alternative of facing the certainty of nonunion. The decision is usually a compromise, the result is unsatisfactory, and, in the end, difficult bone grafting operations must be done. Personally I am for accepting the shortening process as the lesser evil.

Judging from what I see of end-results, I fear that the problem of handling compound injuries needs constant attention, constant emphasis. It is odd but true that the results in our great hospitals do not seem to be much better than are those in the less favored institutions. Perhaps none of us has as yet quite recognized the seriousness of these injuries and the vast cost of poor results, not only to the individual, but to the public. Perhaps we have not quite done our duty in so organizing our services as to furnish the best skill and care in their handling so as to minimize the chance of mischance.

DISCUSSION

T. TURNER THOMAS, M.D., F.A.C.S., Philadelphia: Lack of experience prevents me from discussing neurogenic contractures. The compound injury that interests me most is the compound fracture. A surgeon who served his hospital interneship in 1879 and 1880 told me that most compound fractures then seen by him were expected to die from sepsis. We have made much advance since then. I should like to emphasize my experience with one phase of this problem. The probable common conception of the character of the usual wound in these cases is that it extends directly from the small skin opening to the site of fracture and that the size of the interior of the wound bears a definite relationship to that in the skin, as in a gunshot fracture in which the wound is largely limited to the track of the missile. This is due to the common belief that the injury is the result of a direct blow from some external wounding

object. For the past 12 years I have been swabbing out the interior of the wound as thoroughly as possible with tincture of iodine followed by alcohol and in all cases but one, obviously due to direct violence, have found a very large, irregular cavity, requiring an unusually long forceps to be certain that all parts of the wound are reached by the swabbing gauze pad. I have dèbrided but one case, in the leg, in which I removed the edges of the small skin and subcutaneous tissue wound over the antero-internal surface of the tibia and found that I could not close the wound as I desired because the remaining thin layer of tissue was too adherent to the bone. The cases in which I preserved all of the tissue did very much better. The term implies that the whole wound is dèbrided. This can not be done to the whole interior surface of these wounds as I have found them. The large blood vessels and nerves are close to the bones and therefore to their fragments which are largely denuded and can not be dèbrided, so that the difficulties and dangers are prohibitive.

The only explanation for such large interior and such small skin wounds is that the fracture is commonly due to indirect violence which tears the fragments from their attachments and thrusts the end of one of them through the overlying skin, the protrusion of which best accounts for the usual small skin wound. Very rarely have I found it necessary to pick any dirt from such wounds. The lesson I have drawn from these observations is that the wounds in most compound fractures are potentially clean. With thorough swabbing of the interior of the wound by tincture of iodine followed by alcohol, and with as thorough fixation of the fragments as possible by strong traction or by plates and screws, the wound was closed without drainage and infection has not occurred at all or has not been serious, except in two cases in which gas gangrene developed. The iodine and alcohol seemed to check the growth of the gas bacillus but only temporarily. The first case occurred 8 years ago, involved the leg, and was stopped promptly by a guillotine amputation in the middle of the thigh. The second case occurred recently, involved the forearm, and cleared up quickly after a similar amputation in the middle of the arm.

My interest and experience with contractures of the hand, like those of Dr. Koch, have been in connection with infections and wounds. I am particularly interested in his infection cases involving the tendon sheaths of the fingers. I have seen excellent slow recoveries of function after the healing of palmar abscesses with their severe inflammatory infiltration, fibrosis, contractures, and impairment of hand and finger movements which threatened to be permanent. But I cannot recall a case in which recovery of flexion and extension of the finger occurred after the flexor tendon sheath of a finger had been opened for suppurative infection or for the suture of a divided tendon. Of all of Dr. Koch's recoveries shown here none is so remarkable to me as the two involving the flexor tendon sheaths. I have always thought that the extensive strong adhesions which develop between the tendon and its close fitting tendon sheath would never be sufficiently absorbed to permit the tendon to slip forward and backward again within its sheath. Dr. Koch has shown us a case, however, with such an infection of the thumb and little finger sheaths which were opened and drained and after healing fairly good movements of these fingers returned in 11 days. Of far greater value still he shows us a case in which a portion of the tendons of one finger sloughed away and after healing was complete the scar tissue and the remains of the tendon sheath were excised and two pieces of tendon from the foot were substituted for the lost finger tendons and as a result the extension and flexion movements of this finger were restored almost to the normal. I had always thought that such fingers must remain practically useless and seriously invite amputation.

CHARLES F. NASSAU, M.D., F.A.C.S., Philadelphia: Professor Foerster has clearly and splendidly outlined the various surgical procedures of value in the treatment of neurogenic contractures. In nerve lesions which are irritative in character, when the physiological and anatomical continuity of the nerves is uninterrupted, the removal of a discoverable cause will aid greatly in overcoming the contracture.

The value of neurolysis as an addition to other surgical measures is often disappointing and the further use of endoneural neurolysis may result in an interstitial fibrosis. There are, however, no substitutes for neurolysis, and good results are obtained in probably from 40 to 50 per cent of cases. The reasons for occasional failure become evident when one considers the normal repair process in nerve fibers. When a so-called purely sensory nerve is involved as the result of scar inclusion or pressure, avulsion of the nerve becomes the advisable surgical measure. In some instances following the suture of a nerve, fibrous union takes place between the nerve ends sutured without nerve regeneration. In such cases it becomes necessary to excise the site of the suture and resuture the nerve, since the new nerve fibrillæ are diverted by the fibrous tissue.

As stated in his paper, Professor Foerster makes very little use of resection of rami of the sympathetic nerve system for the sound reason that the operation does not rest upon a firm physiological basis. The procedures of total or partial deafferentation or deefferentiation rest upon the sound premise of inducting a distinct break in the reflex arc and thus aiding to overcome the contracture present. Equally good results are reported either by total or partial sensory nerve section or by total or partial motor nerve section; witness the treatment of torticollis. Favorable results are noted after section of afferent fibers, as well as after section of efferent fibers.

Recently Dandy has reported two successful results in treatment of torticollis following the intradural section of efferent (motor) fibers of the first three cervical nerves: in addition, both spinal ac-

sory nerves were sectioned by means of small incisions in the neck.

The type of case discussed by Professor Foerster is inherently among the most difficult encountered in the realm of surgery in which to effect relief or cure. His results speak for themselves and surely merit the highest praise and commendation.

The writings of Kanavel, Koch, and others have placed the treatment of infection of the hand upon a sound foundation and are familiar to every student of surgery. Koch has wisely emphasized the necessity of early mobilization to prevent the crippling and disabling contractures seen only too often. Many crippled hands could be prevented by carefully planned operation and painstaking after-care.

Tendon and fat grafts are extremely susceptible to infection and asepsis must be rigid to the last degree. In crippled hands with much scar tissue it is best first to replace the scar with new skin by means of a whole thickness, pedicle or tubular graft. In the dissection of a large cicatrix, it is often advisable at the first operation to free up all the structures and perform a pedicle graft. Subsequently, tendon repair or tendon grafts, if necessary, are carried out. In severe cases several operations may be required, and the operations are often extensive and tedious. These cases demand extreme care on the part of the surgeon and the co-operation of the patient, but, as Koch shows, excellent results can be obtained. Koch's results in these difficult cases are evidence of the successful utilization of the principles of the treatment that he has so brilliantly applied. With the use of the methods and procedures he advises many formerly hopelessly crippled hands can be restored to economic usefulness.

Dr. Cotton stresses the change from the gloomy picture of olden days to the more satisfactory and sometimes beautiful picture of a compound fracture in the present day. There is, however, always a most serious side to any compound fracture. Dr. Cotton is fortunate in practicing in a community where tetanus is not prevalent. In my own work in Philadelphia I distinctly remember the days before tetanus antitoxin was used routinely as a prophylactic when the incidence of tetanus in compound fractures was very high and the mortality, of course, nearly 100 per cent. In the last 15 years in two active hospital services we have never had tetanus develop in any compound fracture that had received a prophylactic dose of tetanus antitoxin within a few hours after injury. I have perhaps been extremely fortunate in never having seen a death from serum reaction. Gas bacillus infection in Philadelphia is extremely rare. I have seen only one case and that in a woman gored by a cow and I have seen one other in a patient in a small country hospital following compound injury.

I agree with Dr. Cotton that every compound fracture, however small the opening, should be treated as though it were already an infected wound. Dr. Cotton has discovered the proper method of suture in closing compound fractures, having no part of his wound under tension and using probably one suture where three could be used.

I am delighted to see also that he thinks well of the Smith bone clamp. I have used it for a number of years in selected cases and have seen it hold a fractured femur where the screws of a Lane plate had previously pulled out.

Dr. Cotton's good results are because of his good surgery and the application of sound surgical principles. He regrets and so should others that these fractures frequently do not receive the care to which they are entitled. I believe that a compound injury should be just as much of an emergency as an operation for acute appendicitis.

SPLINT GRAFTS IN THE TREATMENT OF DELAYED AND NON-UNION OF FRACTURES[1]

D. B. PHEMISTER, M.D., F.A.C.S., CHICAGO
From the Department of Surgery of the School of Medicine of the University of Chicago

FOR a long time after the introduction of free tissue transplantation, the skin graft was about the only type of graft that was of any practical importance. Within the last 25 years there has been a steady increase in the use of bone as a free transplant and now it ranks at least equal with skin as a therapeutic agent. Its greatest usefulness has been in the field of ununited fractures where treatment by bone transplantation has become almost a routine procedure. This advance has been due both to improvements in operative technique and to a better understanding of the behavior of bone grafts under various environments. Developments in technique have led to the use of complex operative procedures consisting of resection of fragment ends, correction of alignment and position of fragments, and the use of a bone graft, for the purposes of bridging the fracture line, internal fixation of fragments, and osteogenesis. On the whole these operative procedures have given better results than the earlier and cruder ones although the complicated operations are not entirely free from drawbacks.

As to the behavior of bone in different environments, it has been demonstrated that osseous tissue, regardless of the portion of the bone in which it is located, behaves the same in its reparative response to injury and loss of substance. Thus, the endosteal surface of a whole thickness graft or the inner surface of an osteoperiosteal or sliver graft will unite with the periosteal surface of the shaft when made to bridge the fracture line just as readily as an inlay graft will unite with the cortex when embedded in it. In other words, it is not necessary to bring periosteal side in line with periosteal side and endosteal side with endosteal side in order to obtain bone repair. It has also been observed that once a bony bridge is established across a portion of a fracture line, the remaining intermediary callus will almost always ossify, provided the fracture is adequately immobilized and protected from weight bearing. Also, it has been established that bone taken from the neighborhood of an ununited fracture which has led to atrophy is usually not as satisfactory material for bone grafting as healthy bone taken from another part of the body.

In general, ununited fractures have been treated by three types of bone grafts, namely, intramedullary, inlay, and onlay or splint grafts. Simple intramedullary bone grafts for cases of non-union have justly been largely abandoned because of the frequency with which non-union persists. However, the little used sliding graft of Hoglund affords a reliable method of treating fresh fractures and early delayed union that require operation because of displacement. A graft is cut from the cortex of the longer fragment beginning 1 to 2 centimeters from the fracture and of a breadth that will fit snugly in the medullary cavity. It is introduced into the medullary cavity of that fragment at the fracture end. The fragments are then aligned and the bone graft driven outward by hammering on a chisel placed at a right angle on its end through the window until roughly one-half of it rests in the medullary cavity of one fragment and the other half in the other. The collar of cortex left at the end of the fragment prevents the ends from becoming displaced. Its use is illustrated by the case shown in Figure 1. *A*, Shows a fracture of radius and ulna of 2 months' duration with delayed union because of malposition; *B*, shows the condition 2 months and *C*, 2 years after open reduction and fixation by intramedullary bone grafts cut from the upper fragments, by the Hoglund technique. However, I warn against its use in frank non-union as I have had some failures in such cases.

Inlay grafts when well used have been found to give successful results in a high percentage of cases. Albee, who implants

[1]The Fracture Oration presented before the Clinical Congress of the American College of Surgeons, Philadelphia, October 13-17, 1930.

Fig. 1. A, Displacement and delayed union 2 months after fracture. B, Two months after Hoglund sliding grafts cut from *a*. C, Result 2 years after injury.

either a rectangular or a double wedge-end inlay into a cortical slot sawed into the side of the fragments, recently reported bony union in 89 per cent of 754 cases operated on. However, he often adds sliver grafts laid externally across the fracture line which aid much in the success of the operation. A drawback to the rectangular inlay graft is that it sometimes becomes displaced from its bed or fractures because of its small size, resulting in continued non-union. A heavier and more stable inlay is obtained in case of ununited fractures of large bones, particularly humerus, by a graft cut from the anterior surface and crest of the tibia which, when implanted on edge, is broad enough to fill not only the window cut in the cortex but to extend across the medullary canal. It should fit very tightly in the cortical slot and should be further immobilized by kangaroo tendon passed through holes drilled in graft and fragments.

Figure 2 shows a non-union of the humerus of 1½ years' duration, which was repaired in this way. *A*, Shows the condition before operation; *B*, the graft in position 10 days after operation; and *C*, the bony union 7 months later. An additional means of anchorage of such a graft is to make it 2 centimeters longer than the slot cut in the cortex and prepare a shoulder at either end, which is sunk

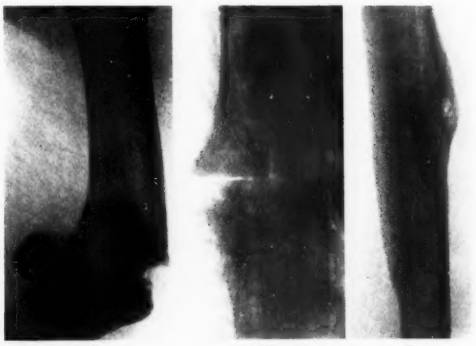


Fig. 2. A, Non-union of humerus of 18 months' duration. B, Ten days after resection and fixation by heavy graft inlaid on edge. C, (Print reversed.) Result after 7 months.

into the medullary cavity of the fragments as shown in Figure 3.

The onlay or splint graft is applied externally to the bare surface of the fragments. It has been most extensively employed for fixation, bridging, and osteogenesis. Its use in this way is best exemplified by the operation of Henderson (3) in which a strong, whole thickness transplant is applied to a flattened surface of the fragments and fixed by means of beef bone screws. Additional unfixed grafts in the form of splinters and cancellous bone may be laid along the surface across the fracture line. The results reported for Henderson's procedure have been at least as satisfactory as those reported for any other method of bone grafting for ununited fractures.

The objection to these more complex operations is that the amount of traumatism, the technical difficulties, hæmorrhage, general reaction, and risk of infection are sometimes greater than in more simple procedures, and occasionally give rise to serious trouble. However, the advantages so far outweigh the

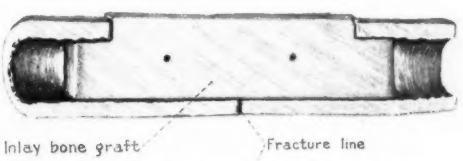
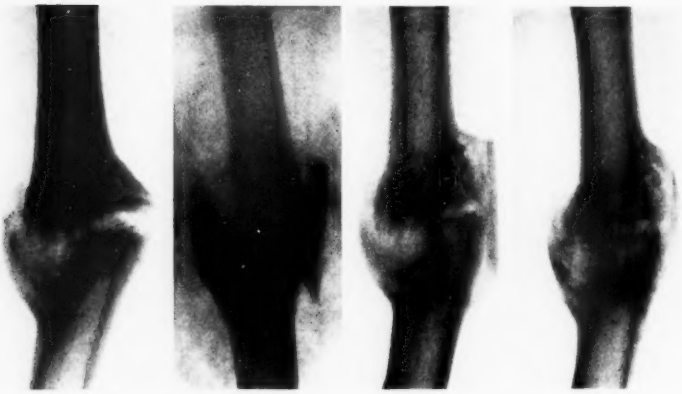


Fig. 3. Method of fixation of heavy inlay graft inserted on edge.



A B C D

Fig. 4. A, Non-union of 13 months' duration. B, Two grafts laid across fracture line. C, Fusion of grafts with fragments and extensive ossification of intermediary callus 3 months after operation. D, Bony union complete 7½ months after operation.

disadvantages in cases in which realignment, approximation, and fixation of fragments are necessary that one of the procedures should routinely be employed.

SIMPLE SPLINT GRAFTS

I want to consider a group of cases in which a more simple onlay or splinting operation may be performed that yields better results than the complex procedures. There is a group of cases of delayed or non-union in which both alignment and approximation of fragments are so satisfactory that if bony union could be obtained without altering them it would give an acceptable clinical result. In such cases it is possible to apply grafts that are intended to serve not for immediate fixation but only as bridges and as a source of osteogenesis leaving fixation to pre-existing callus, to an associated splint bone, or to external appliances.

Delangeniére introduced osteoperiosteal grafts for the treatment of such cases. The seat of fracture is exposed and the surrounding periosteum and soft parts reflected from the entire circumference of the fragment ends. Three to 6 osteoperiosteal strips 3 to 5 centimeters in length are chiselled off of the tibia and laid along the surface of the fragments. The intermediary callus may be partly or wholly gouged out or it may be left undisturbed according to the case. The soft parts which are then sutured hold the grafts in contact with the surface of the bone. A period of immobilization follows. The operation is quickly and easily performed and is less likely to stir up latent infection or give rise to new infection than the more traumatizing ones in which a fixation graft is employed. It leads to bony union in a large percentage of cases.

In certain other cases one or sometimes two large whole thickness splint grafts applied to one side of the fracture offer a better method of treatment than do osteoperiosteal grafts. A strong bony bridge established by bony union of the graft to the two fragments is more likely to be followed by ossification of the intermediary callus than is a weaker bony bridge such as is furnished by osteoperiosteal grafts; also, bony union takes place more rapidly.

This is well illustrated by Figure 4, in which a non-union of the femur of 13 months' duration in a man, aged 43 years, was operated on by Dr. G. M. Curtis. Delivery and resection of the fragment ends with fixation by means of an inlay or onlay graft would have meant a big operation with its concurrent risks. The fracture was exposed laterally and two whole thickness grafts from the tibia were made to bridge it, one posteriorly and the other laterally after the exuberant bone was chiselled off.

A B C D

Fig. 5. A, Non-union of infected fracture of tibia. Sinus recently healed. B and C, Bony union after insertion of heavy splint graft to side of tibia opposite point of infection. D, Further consolidation 5 months after C.

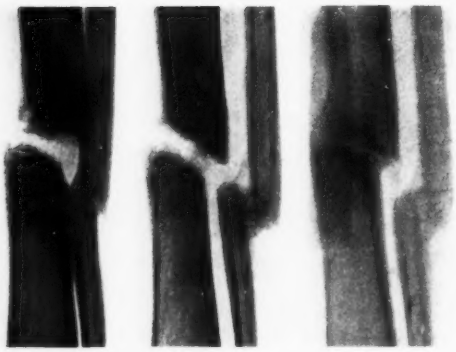
The intermediary callus was not disturbed and the grafts were held in place by the sutured soft parts. A body and leg cast was worn for 2 months during which time bony union between grafts and fragment ends was established. This was followed by rapid ossification of the intermediary callus. The patient was walking on the limb without assistance at the end of 4 months.

In some cases of non-union of infected fractures, the infection persists along only one side of the bone. A whole thickness splint graft may be inserted along the opposite side soon after the infection has healed, thereby saving much time, since any other type of operation would necessitate entrance of the recently infected field and could not be done safely until several months later.

Figure 5 illustrates the case of a male, aged 23 years, who had an infected ununited fracture of the tibia which resulted in sequestration of a portion of the anterior cortex of the lower fragment. This was removed at the end of 7 months. Three weeks later the anterior sinus leading to the seat of fracture had healed. Through a posteromesial incision, a heavy whole thickness bone graft was then applied along the posterior side of the tibia with its periosteal side outward. A cast was applied for 2¾ months at the end of which time there was bony union between the graft and the fragments and the intermediary callus of the fracture was ossified. Walking was then resumed and further solidification of the fracture followed.

Figure 6 illustrates the case of a male, aged 28 years, who had an ununited infected fracture of the tibia of 5½ months' duration with sequestration of 1 centimeter of the upper fragment leaving a defect in the bone after sequestrectomy 10 days before, *A*. A sinus led to the posterolateral part of the defect. At operation the fracture line was exposed through a short transverse incision, and the end of each fragment freshened without separating soft parts from its sides. The fibula was then refractured and the ends of the tibia were jammed together, the fibular fragments overriding. A cast was applied and the wound in the soft parts healed promptly. The fibula united, but the tibia still showed an incompletely ossified callus at the end of 5 months. A whole thickness bone graft was then inserted opposite the old field of infection. The wound healed without infection and there was prompt bony union of the graft with fragments and of the fragments with each other so that after 2 months the patient was able to walk on the limb.

There is a further group of ununited fractures either congenital or acquired occurring in children, the most important being con-



A B C

Fig. 6. A, Defect in tibia 10 days after removal of sequestra in infected compound fracture of 5½ months' duration. B, Non-union of tibia 2½ months after jamming ends together following refracturing of fibula. C, Two and one-half months later tibia still ununited. A heavy splint graft was introduced. This figure shows union 2 months later.

A B C D

Fig. 7. A, Congenital pseudarthrosis of tibia. Shows union between graft and fragments 4 months after operation. B, Shows intermediary callus unossified 13 months after operation. Graft fractured at seat of old fracture line. C, Bony union 8 months after application of two whole thickness splint grafts, mesially. D, Shows result 3½ years after last operation.

genital pseudarthrosis of the tibia in which there is likely to be failure of bony union after repair by use of the ordinary methods as shown by the report of Henderson (4). In such cases the application of two or more additional encircling whole thickness splint grafts may lead to bony union which remains permanent.

A girl, aged 8 years, had had four previous operations for congenital pseudarthrosis of the lower third of the left tibia without success. The fragments were freed, aligned, and fixed by a broad graft from the other tibia applied laterally and anchored by encircling kangaroo tendon ligatures. Figure 7 shows the bony union between fragment ends and the transplant when the cast was removed at the end of 4 months. There was no ossification of the intermediary callus. At the end of 13 months of cast treatment, the intermediary callus was still ununited although the transplant had undergone some hypertrophy. Walking at that time resulted in fracture of the transplant. Two broad, whole thickness grafts 3 inches long were then cut from the regenerated right tibia and laid along the anteromesial and posteromesial sides of the fragments without interference with the intermediary callus. They fused with the fragments and the intermediary callus ossified as shown in Figure 7*C*. The patient walked on the limb after that and Figure 7*D* shows the appearance of the bones 3 years and 2 months after the last operation.

As to the results with the use of the splint graft in non-union without fixation to the fragment, the osteoperiosteal graft has been used alone in 13 cases and the whole thickness graft in 11 cases. Bony union has been secured in every instance. If the cases were to be done over the whole thickness splint graft would be used in some of those treated with the osteoperiosteal graft because of its simplicity and of the greater rapidity with which bony union follows.

SUMMARY

Ununited fractures in which there is little or no displacement or angulation of fragments may be treated satisfactorily by the simple application of whole thickness splint grafts or in some cases of osteoperiosteal grafts to the fragment surfaces bridging the fracture line and held in place by the sutured soft parts. Intramedullary grafts are unsuited for cases of non-union but the Hoglund sliding graft may be used in fresh fractures and in delayed union where marked displacement of fragments is the indication for operation. A broad inlay graft which is turned on edge and

made to fill both medullary cavity and slot cut in cortex affords a suitable method of treatment of some cases of non-union of large bones.

REFERENCES

1. ALBEE, F. H. Principles of the treatment of non-union of fracture. Surg., Gynec. & Obst., 1930, li, 289.
2. DELANGENIÈRE and LEWIN. A general method of repairing loss of bony substance and of reconstructing bones by osteoperiosteal grafts taken from the tibia. Surg., Gynec. & Obst., 1920, xxx, 441.
3. HENDERSON, M. S. Non-union in fractures; the massive bone graft. J. Am. M. Ass., 1923, lxxxi, 463; Massive bone graft applied for non-union of humerus. Surg., Gynec. & Obst., 1928, xlvi, 397.
4. Idem. Congenital pseudarthrosis of the tibia. J. Bone & Joint Surg., 1928, x, 483.
5. HOGLUND, E. J. A new method of applying autogenous intramedullary bone transplants and of making autogenous bone screws. Surg., Gynec. & Obst., 1917, xxiv, 243.

SURGICAL TREATMENT OF CEREBRAL TUMORS

TECHNICAL CONSIDERATIONS[1]

DR. THIERRY DE MARTEL, PARIS, FRANCE

IN this article, which is a résumé of my report to the Congres International de Neurologie, it is my purpose to show how, in my own practice, improvement in technique has brought about better results in intracranial surgery. I will also describe the mechanical equipment we have adopted and the special methods we employ in operating upon and removing tumors of the brain.

POSITION OF PATIENT AND THE ANÆSTHETIC

First of all, in what position should the patient be placed for operation on a cerebral tumor, and what anæsthetic should be used? These two questions are of importance.

Since 1913 I have endeavored to demonstrate that the sitting position when local anæsthesia is used is a great advance in neurological surgery. At the present time some surgeons have come to share this opinion, while others insist that there is nothing new in this procedure.

On many occasions, neurologic surgeons have, of course, attempted to operate or have operated with the patient in an upright position. They have also used local anæsthesia in operations upon tumors of the brain. However, I believe that I am the only one so far who has insisted upon the routine use of local anæsthesia with the patient in the sitting position during operations on brain tumors. At least I have been unable to find reports that any one else has fully acknowledged the value of this technique and has adopted it as a routine method. In certain excellent books of more recent date, the method scarcely receives mention.

In the commendable work of Olivecrona which deals entirely with surgery of brain tumors, the author contents himself with saying that the sitting position of the patient diminishes hæmorrhage, but that the method should not be adopted routinely because the operative field is more accessible to the surgeon if the patient is lying on the operating table.

At the Society of Surgery of Berlin, February 13, 1912, Bier declared that local anæsthesia could be used in operations on the brain but he did not mention in what position the patient should be placed. At the same conference, Haertel stated that he employed local anæsthesia in surgery of the gasserian ganglion. Borchardt likewise recommended local anæsthesia for cranial operations.

The same year, at the German Congress of Surgery, Kuettner enumerated the advantages of local anæsthesia. He plainly stated that with this anæsthesia one could always operate with the patient in the sitting position and that the sitting position presented two great advantages, namely that respiration was made easier and that hæmorrhage was diminished. Eiselberg and Ranze, in their voluminous treatise bearing on 100 cases, stated that in their practice inhalation anæsthesia was preceded by the injection of one-half per cent novocain solution. This pro-

[1] Presented before the Clinical Congress of the American College of Surgeons, Philadelphia, October 13-17, 1930.

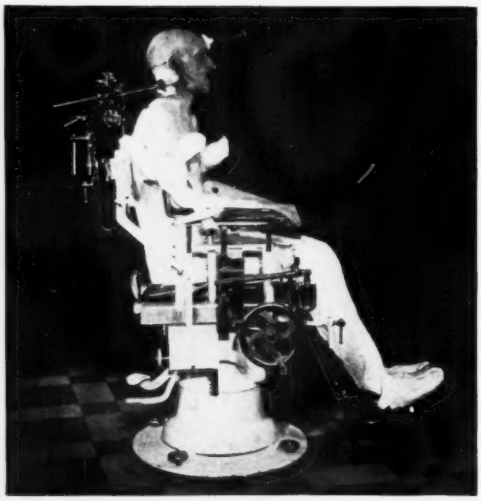


Fig. 1. The patient is in position for a hemi-craniectomy. The surgeon can operate as easily on the front of the head as on the occipital region.

cedure permitted them to give less anæsthetic and also tended to diminish the amount of hæmorrhage. They placed the patient in a semi-sitting position, and an assistant held the patient's head.

Krause chose the sitting position with the patient's thorax and shoulders raised to an angle of 45 degrees only for operations on the posterior cranial fossa.

With these few exceptions there seems to be no other mention of the sitting position in the literature. In England and in Belgium, and likewise in Switzerland where I spent much time before the war, I saw no neurologic surgeon use local anæsthesia and operate with the patient in the sitting position. No mention was even made of this technique.

In the United States, whose medical literature I knew thoroughly before the war and since have followed closely, I have never seen it advised that in intracranial surgery local anæsthesia be routinely associated with the sitting position. As a matter of fact, however, I have seen a few surgeons, particularly Frazier, who place their patients in the sitting position for operation on the gasserian ganglion. Occasionally they elevate the head of the patient for other cerebral operations, but they use general anæsthesia. The great brain surgeon, Cushing, who has an immense practice and is thoroughly acquainted with all the details of brain surgery, employed neither local anæsthesia nor the upright position in his operations. Even up to the time of the war, he combatted the idea of local anæsthesia although he recognized the fact that I was in favor of it. He partly accepted my viewpoint and began using local anæsthesia during the war, however. Now he uses it extensively and does many operations by this method, although he always places the patient in the horizontal position.

Adson, whom I have seen operate and who also has visited my clinic in Paris, has written me that he has been immensely interested in the method which he saw me use, and that he proposed to employ it himself. Eagleton too was favorably impressed with this technique.

This year I saw my friends Stookey, Elsberg, and Taylor operate upon the gasserian ganglion with their patients in a sitting position, but in operations on the brain, the patients were placed in the horizontal position. This fact would seem to indicate that it was not for the patient's welfare but simply for the convenience of the operator, so that better exposure of the operative field could be obtained, that the patient was kept in the upright position for gasserian ganglion operations.

If I insist so much on this point, it is because I am extremely desirous of knowing whether or not the method, which I have adopted, should be employed routinely or should be abandoned. At the present time the majority of neurologic surgeons do not believe in the wisdom of the procedure and only a few of the younger surgeons have adopted it.

In 1907, when I did my first cerebellar operation, I had no personal view on the question. I simply used the position which Cushing had endorsed for 10 years, that is, the ventral decubitus position, the head and the shoulders reposing on special supports and the patient under general ether anæsthesia. I had some special supports made which I used for operations on the cervical cord, with the patient in the same prone position. These supports were described in an article in the

Fig. 2. The black tracing indicates the limits of the flap in a cerebral exploration.

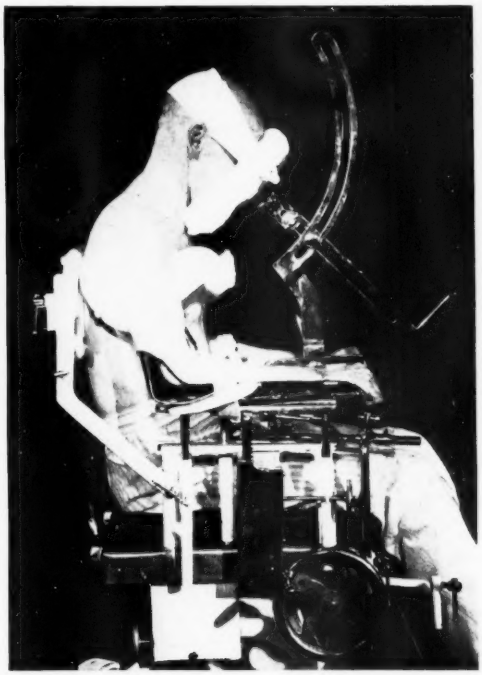


Fig. 3. The patient prepared and in position for a cerebellar trepanation.

Revue de Chirurgie. For all other cerebral or spinal cord operations, patients were placed on an ordinary table, in a dorsal decubitus position, with the head more or less elevated.

Soon, however, I learned that the horizontal position for operations on the brain was not the best, and that the prevention of hæmorrhage, the principal obstacle, was a problem of great importance in neurologic surgery. The provocation of hæmorrhage should be reduced to a minimum. This is far more important than to look for measures to control hæmorrhage after it has occurred. It is of the utmost importance to diminish venous hæmorrhage, which is treacherous and difficult to control. The position of the lowered head greatly favors the refilling of the cephalic veins which have no valves. Respiration is rendered difficult when the patient is lying down and when a general anæsthetia is used, for general anæsthesia always causes more or less asphyxia, thus favoring venous hæmorrhage, since one of the results of asphyxiation is the embarrassment of the return circulation.

From these simple observations, the conclusions follow that the head of the patient should be placed high. In cranial operations the sitting position, which favors easy respiration and is the position all patients assume instinctively when respiration is labored, is best suited to the needs of both the patient and the surgeon. It is also evident that an anæsthesia tending to cause asphyxiation should not be used. Before going further, I should like to call your attention to the fact that there is a great difference between the sitting position and the lateral decubitus position when a table is tilted at 35 degrees as proposed by some authors, especially Frazier.

In order to solve the problem of anæsthesia, I have tried various procedures, among which are the use of general anæsthesia with the Roth-Draeger apparatus (oxygen and chloroform). The anæsthetic, which consists of a mixture of nitrous oxide and oxygen under pressure, according to the method of Paul Bert, has given excellent results, but in actual practice the technique of its use became very

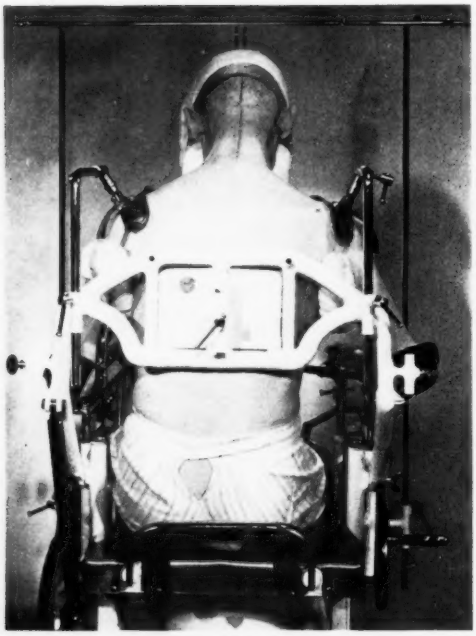


Fig. 4. Back view of a cerebellar flap.

Fig. 5. The way in which the patient should be placed for an operation on the dome of the skull. At any moment of the operation, the position of the patient's head can be changed.

difficult. I also tried administering anæsthetics by methods other than through the respiratory passages, such as the intravenous injection of etherized salt solution and the instillation of ether into the rectum. These last methods gave some very good results, but they had their disadvantages. Although intrarectal ether instillation gave some good results, it frequently threw the patient into a state of agitation which proved very annoying.

It was then that I tried local anæsthesia. De Quervain had previously informed me that he had done trephine operations under local anæsthesia for cranial traumatisms. I have always hesitated to undertake prolonged cerebral operations for tumors with local anæsthesia, but after once trying it, I was astonished at the perfect results obtained.

Since 1913, this method which I call my own (that is the routine employment of local anæsthesia with the patient in the sitting position) has not been altered. The only reason I have for calling it my method is that no other surgeon has insisted on the routine use in cranial operations of local anæsthesia with the patient in the sitting position. Many French surgeons, as well as surgeons of other countries, have visited my clinic and have witnessed brain operations by this method. Some who formerly criticized it now employ the technique themselves. For instance, Professor Leriche used this technique, and Dr. Jauregui, student of Professor Chutro of Buenos Aires, and Dr. Christophe have had built special chairs on which the patient is kept comfortably in position during operation. The chair of Dr. Jauregui in particular is ingenious.

For a number of years, I placed the patient astride a chair with the head reposing on the crossed arms leaning on the end of a table. This position was perfect and entirely natural. The patient was comfortable and no constraint was necessary. However, its regular use was not always possible because some

patients were nervous, agitated, or spastic, and in such cases one was obliged to use general anæsthesia and at times moderate constraint but we attempted to keep the patient comfortable. For 8 years, from 1916 to 1924, I used a very simple chair which has given me great satisfaction. The only inconvenient feature was that the change to the horizontal position in case of syncope was too slow. Since that time, I have had constructed with the aid of Guyot and his excellent collaborators, MM. Schosseler and Julien Bouvier, a chair which I am still endeavoring to perfect. This chair is represented in its present state of evolution in the accompanying illustrations. On the day preceding operation, the patient is made familiar with the proper position in the chair, so as to avoid wasting valuable time at the moment of the operation.

For all operations on the cranium, except occipital trepanations, the patient is seated with his back against the back of the chair, and his trunk held by two padded supports which uphold the trunk from the axillæ, the supports being so arranged that they do not cause too great pressure. These crutches can be adjusted to each patient. The head is maintained in the best possible position by three metallic hands covered with rubber which support the cranium from convenient points. The mask, which covers the nose and mouth, also aids in holding the head by supporting it from the facial prominences. Once these four parts, the three hands and the mask, are fixed in good position, with only light pressure exerted on the points to which they are applied, it is impossible for the patient to move his head, as can readily be seen. The patient once placed in position is always tilted slightly backward; thus the weight of the body falls on the back.

In operations on the occipital region, the patient reposes on the mask which is applied to the facial prominences and the chair is tilted forward. The sliding of the patient is prevented by placing a *troussequin* between the thighs which is applied against the symphysis pubis. This support is movable backward and forward. For operations on the spinal cord, the patient is placed in a position analogous if not identical to that for occipital operations. The back of the chair is raised or lowered easily by means of a simple apparatus and, in a few seconds, the patient can be put in a horizontal position. The head can be lowered even below the level of the feet, a position often rendered necessary by either sudden or progressive fall of blood pressure, which is constantly recorded during the operation.

The use of this chair renders surgery of brain tumors infinitely easier. The operator works on the head which is immobile and is fixed as securely as a piece of wood on a carpenter's table. The patient makes no effort to hold himself and often goes to sleep during the operation. Throughout the operation, the surgeon may converse with his patient and this is a valuable means of control, for if the patient is gradually losing consciousness, the surgeon notes the fact as the patient's responses are made with difficulty. In such instances, it is necessary to postpone the completion of the operation, especially if the blood pressure falls at the same time. Usually, however, if the patient's head is lowered to the level of the feet, he immediately awakens. Generally in cranial operations when a patient seated and under local anæsthesia, passes from a wakened to a sleeping state, it is a grave complication. The risk is greater, however, if the same patient is in the horizontal position and under general anæsthesia. Then he is seen to pass from a sleeping state into death.

Since the foregoing deals only with technical problems, it may not be very interesting to most of you. However, I believe the technique we have developed is valuable. In my clinic it is mostly to it that I owe the reduction in mortality in ablation of cerebral tumors. From 60 per cent, 15 years ago, the mortality fell to 50 per cent, and then to 20 per cent which, according to statistics, is the present death rate.

REFERENCES

1. BIER. Hirnoperationen unter Lokalanesthesien. Zentralbl. f. Chir., 1913, ii, 1366.
2. EISELBERG and RANZE. Ueber die chirurgische Behandlung der Hirntumoren. Verhandl. d. deutsch. Gesellsch. f. Chir., 1913.
3. KRAUSE. Die allgemeiner Chirurgie der Gehirnkrankheiten. Neue deutsche Chirurgie, 1914, xii, 492.
4. KUETTNER. Was erreichen wir mit unseren unter Diagnose: "Hirntumor" ausgefuerten Operationen? Verhandl. d. deutsch. Gesellsch. f. Chir., 1913.
5. OLIVECRONA, H. Die chirurgische Behandlung der Gehirntumoren: eine klinische Studie.

FUNDAMENTAL PRINCIPLES IN THE TREATMENT OF ACUTE EMPYEMA[1]

AMBROSE L. LOCKWOOD, M.D., C.M., F.A.C.S., TORONTO, CANADA
Section of Surgery, Lockwood Clinic

SINCE the earliest times few diseases have been more perplexing to the profession generally, with regard to treatment, than empyema. Even in this advanced era of medical and surgical development that there is not sufficient agreement on this point, is evident from the diversity of methods advocated, the constant occurrence of chronic empyema, and the extreme range of mortality incidental to treatment by various procedures.

SERIOUSNESS OF THE DISEASE

In spite of the recent advances in methods of treatment employed in empyema, it would be unfortunate if we forgot, or failed to impress on the younger generation, the great dread with which the development of an acute empyema was observed prior to the war. It is well for us to remember the alarming febrile reaction, the grave consultations as to the proper time for operative intervention and the risk, the high mortality rate, the large percentage of chronic empyemata, the long drawn-out convalescence, the distressing sequelæ and the repeated operations necessary for the final obliteration or closure of the cavity in the chronic stage of the disease.

TREATMENT BEFORE AND SINCE THE WAR

Before the Great War it was believed that if thorough drainage was secured little else was required to effect a cure in empyema. That such treatment was not always sufficient was borne out by the numbers of emaciated, anæmic, deformed, and mutilated patients suffering from chronic empyema, who were constantly to be found in all our large hospital clinics. The high mortality (50 per cent to 70 per cent in children, and 20 per cent to 30 per cent in adults) impressed us deeply with the gravity of the disease and the inadequacy of the treatment employed. Fortunately, streptococcal empyema was rare. As a result of the extraordinary development of thoracic surgery during the war, the study of empyema following traumatic lesions of chest (gunshot and bayonet wounds and stove-in chests) and later experience in the large numbers of empyema cases during the epidemic of influenza, measures were established that reduced the mortality, which in the early stages of the epidemic was as high as 50 per cent and 70 per cent in certain areas, to almost nil in the uncomplicated acute case. The incidence of chronic empyema was also greatly reduced. Mutilating operations, such as the Schede and Estlander, became rarely necessary and re-expansion and complete function of the collapsed lung was obtained in the great majority of patients.

DANGER OF EMERGENCY OPERATIONS

The medical profession should realize that emergency operations on patients who are dangerously ill during the acute stage of the disease are no longer justifiable. Unless the pressure of the fluid is so great that respiratory and cardiac functions are embarrassed or circulation is impeded, early removal of the fluid is not necessary. Instead of saving life, it contributes to a fatal result in most instances.

If the fluid pressure must be hurriedly reduced, aspiration only should be employed. It should be constantly borne in mind that the fluid is first a protective mechanism to splint the lung and stabilize the mediastinum, and that death in the acute stage of the disease is not due to absorption of the fluid itself, but to disease of underlying lung tissue, to involvement of other serous cavities, to pyæmia, or to too early interference with the fluid, followed by collapse of the remaining air-bearing portion of lung tissue resulting in insufficient oxygenation and death. In such treatment, death is not due to the disease *per se*, but to untimely and ill-considered interference by the medical or surgical attendant.

[1]Presented before the Clinical Congress of the American College of Surgeons, Philadelphia, October 13–17, 1930.

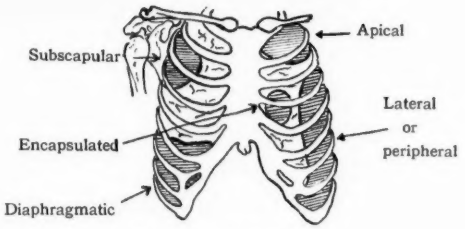


Fig. 1. Types of cavities.

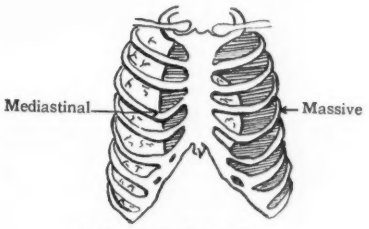


Fig. 2. Types of cavities.

IMPORTANCE OF EARLY DIAGNOSIS AND TREATMENT

The importance of recognizing the condition without undue delay and of immediately calling in the surgical consultant cannot be overemphasized. Delay in diagnosis and treatment of the disease increases the risk of dangerous complications, tends to produce chronicity, and adds greatly to the mortality rate. It is a regrettable fact that in approximately 50 per cent of all cases the disease is not recognized early enough or that proper treatment is at least delayed.

Stereoscopic roentgenograms of the chest anteroposteriorly and obliquely should be taken early and a careful fluoroscopic examination made to determine the relative position and size of the collection.

This is important in deciding the proper site for drainage. The ease of approaching and securing adequate evacuation of the collection varies with the location of it. We must have a clear cut working classification of the various types of empyema, whether apical, subscapular, lateral and peripheral, or central, diaphragmatic, mediastinal, guttural, intralobar, etc. (Figs. 1, 2, and 3).

DANGER OF EARLY ASPIRATION

Diagnostic aspiration should not be resorted to unless it is not easily possible to obtain roentgenograms and then only if a definite area of dulness exists.

Apart from the straw-colored fluid found in tuberculous pleurisy, if the fluid in the syringe is merely flocculent and flows freely, we have aspirated too early, and no more than a few cubic centimeters of fluid should be withdrawn at that time, except for the purpose of relieving dyspnœa. It is astounding and inexplicable how rapidly fluid can accumulate in the pleural cavity, and equally so, how rapidly absorption of even fairly thick fluid may occur within the thorax. The phenomenon of secretion and absorption varies with each case and no one can foretell the course it will take. Being guided by the elevation of temperature, pulse, and respiratory rate, the degree of dyspnœa, the displacement of the heart, and the general constitutional resistance of the patient to the toxæmia, the surgeon should delay removing the fluid even by aspiration until the empyema is well walled off, and the lung about it firmly adherent to the chest wall, so that if air does enter the cavity, or the walls of the cavity collapse as the fluid is withdrawn, the adherent parietal and visceral pleuræ do not separate and what may have been a small self-limiting pocket of pus that might have continued to wall off and absorb or perhaps rupture into a bronchus and be spat up, becomes transformed into a general empyema, occupying a large cavity in the thorax with its attending added area for absorption, increased problems of obliteration,

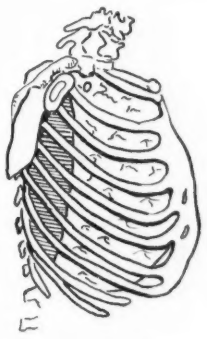


Fig. 3. Guttural type.

and all the dreadful sequelæ that so commonly ensue.

GENERAL CARE OF THE PATIENT

It is obviously difficult to lay down hard and fast rules for treatment in so variable a type of disease as acute empyema. From the onset of the disease every effort should be made to maintain the general resistance of the patient. Forced fluids and foods of high caloric value should be given. Every effort should be made to offset acidosis, by the use of alkalies and sugar in some form, either glucose or barley sugar. Stimulating drugs and antipyretics are of doubtful value. Digitalis in some form possibly may be useful. Sedatives in the form of codein and heroin should be freely used, especially if a distressing cough with intrapleural pain renders it difficult for the patient to rest. Scarlet fever antitoxin may be of great value in fulminating acute streptococcal infections. The patient should be encouraged to lie on the affected side. This helps to splint the chest wall and limit the accumulation. Unnecessary turning and moving of the patient to arrange the bedding, rub the back, and permit of frequent examinations should be avoided. As far as possible, the patient should be nursed in the open air. Early and frequent consultations with the internist, surgeon, radiologist, and bacteriologist, all tend to correct appreciation of the condition of the patient and the best time for interfering with the collection. The apt surgical dictum, *Ubi pus, evacua*, does not apply to all stages of acute empyema.

COMPARISON OF PNEUMOCOCCAL AND STREPTOCOCCAL INFECTIONS

The treatment necessarily varies with the type of the disease. Streptococcal bronchopneumonia extends over weeks. The effusion occurs early during the height of the pulmonary consolidation when the patient is most seriously ill. The acute stage of pneumococcal infection, on the other hand, is limited to a period of days and terminates by crisis, a few days after which drainage may be safely undertaken. Pneumococcal effusions in addition are usually encapsulated and of a relatively small amount as compared with streptococcal collections. There is not the same risk of draining a pneumococcal collection too early because at least 85 per cent of cases do not develop sufficient fluid to be diagnosed until after the crisis. If the crisis has not occurred, however, or a febrile toxic state persists, repeated aspirations only should be employed. After preliminary aspirations, drainage is safe.

RELIEF OF DYSPNŒA IN ACUTE STREPTOCOCCAL INFECTIONS

On the other hand, patients acutely ill with streptococcal infection may develop so much fluid as early as the fourth to the seventh day, that dyspnœa becomes intense and repeated aspirations every 4 to 5 hours may be required for relief. If carefully done, however, the underlying lung is not endangered. In such cases the temperature usually falls, dyspnœa and cyanosis are relieved, the pulse improves, and the patient takes nourishment better. Most of these cases require drainage later, but the risk of the operation is greatly reduced. In a small percentage of patients with streptococcal infection early in the disease, aspirations do not give sufficient relief from the dyspnœa and it is necessary to insert a tube by the trocar and cannula method, in spite of the risk of doing it so early. This is done with the patient in bed, without being moved at all.

The temperature peak curve and the high mortality curve correspond about the seventh day in the acute streptococcal type. The mortality curve falls as operation is delayed from the second to the third week.

DANGERS OF ASPIRATION

Aspiration, usually looked on as a simple procedure, presents certain dangers that should be borne in mind.

1. *Pleural reflex.* A sudden death from aspiration is most distressing to the relatives and extremely embarrassing to the surgeon. It is not a rare phenomenon, cannot be foreseen, and bears no relation to the gravity of the disease.

2. Puncture of a blood vessel or of the lung may produce alarming symptoms.

3. Infections along the path of the needle as previously pointed out may infect an

adjacent cavity, the lung, or the chest wall, and greatly complicate the disease.

As a rule the pus in a pneumococcal empyema is already frankly purulent on the first aspiration. On the other hand, early aspirations in the streptococcal variety reveal flocculent serous fluid that later becomes purulent, and, generally speaking, in this type of infection drainage should be delayed until the fluid is purulent.

AVOID EARLY DRAINAGE

In spite of the danger and nuisance of carrying out repeated aspirations, it is safer to err on the side of prolonging the aspiration rather than to establish drainage too early by any method. The main reasons for avoiding early drainage are:

1. The febrile state is at its maximum.
2. A great portion of the lung is consolidated by the infection and collapsed by the pressure of the fluid.
3. Adhesions are rarely sufficiently dense to prevent collapse of the lung.
4. The patients are bad operative risks with greatly reduced vital capacity of the lung, and dyspnœa and cyanosis due to interstitial parenchymatous lung involvement.
5. Patients are frequently in delirium, do not take nourishment well, and may not cooperate in any way.

OPERATION RARELY INDICATED IN EARLY STAGES

In treating streptococcal empyema, it should be kept in mind that the patient's condition in the early stage of the disease is, as a rule, not due to the fluid *per se*, but to disease of the underlying lung tissue and frequently the other lung as well, and to serious complications such as pericarditis, peritonitis, etc., fulminating types in which removal of the fluid will accomplish nothing and may do harm. Unless the patient is suffering from intense dyspnœa that can be relieved by aspiration, operation is of little benefit. Operation is rarely indicated in an acutely ill patient.

ROUTINE PROCEDURE

The routine procedure which we have employed for the past fourteen years is as follows, the operator being guided by the patient's condition.

1. *Periodic aspirations in the early stage.* Periodic aspirations are employed in the early stage of the disease. A fine needle is used at first and a larger one employed as the fluid becomes more purulent. If the collection becomes so dense that it does not readily flow through the needle, air replacement is employed to hasten the flow. The aspirations are repeated as required. In the early stages of the disease, if the patient is dyspnœic and the fluid reaccumulates rapidly, aspiration is practiced every 5 hours, otherwise twice a day, once a day, or once every 2 days, as required. The pneumococcal empyema rarely requires aspiration more often than once every second day, whereas the streptococcal empyema may require it frequently. When aspirations are performed, just before the needle is withdrawn a little alcohol or 1 per cent mercurochrome—220 soluble, is introduced into the needle with a syringe, and the needle is slowly withdrawn so that the antiseptic escapes into the tract and prevents infection, which should always be avoided and is troublesome, particularly if operative intervention through the same site is necessary later.

Great credit is due to the American Empyema Commission for urging the use of preliminary aspiration, and for stopping early operative surgical intervention which, contrary to the protests of a few, was unfortunately so widely practiced in the years 1917 and 1918.

2. *Closed drainage—Carrel-Dakin treatment.* When the patient is no longer improving or is not holding his own with aspirations, closed drainage is established by the trocar and cannula method. The patient is inclined on the good side over a pillow in bed. After injecting a little local anæsthesia subcutaneously and as deep as the pleura, a small nick is made through the skin and muscle with a fine scalpel and the trocar and cannula is plunged through a dependent interspace, preferably the seventh or eighth space in the posterior axillary line. Instances have been reported of puncture of the diaphragm adherent to the chest wall in establishing drainage in the lower spaces, and even as high as the seventh space anteriorly in

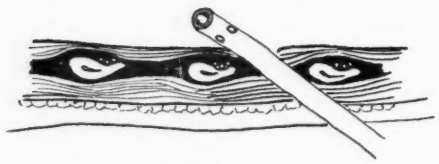


Fig. 4. Oblique position of tube.

the midaxillary line. This is a grave complication, and care should be taken to avoid it.

The arm and shoulder on the involved side is elevated, and the patient is made to arch the affected side out as much as possible, so as to increase the width of the intercostal space. The skin overlying the space is drawn well up and held firmly while the trocar and cannula is passed in an oblique upward direction, so that when the patient is put at rest the tube is lying in an oblique plane pointing upward and the tissues tend to make a valvular closure about it (Fig. 4). The trocar is passed just above the upper border of the lower rib, so as to avoid puncturing the intercostal artery or injuring the nerve. The tube extends about 3 centimeters into the cavity. Cannulas of various sizes are at hand, and the largest size that can be inserted conveniently through the interspace is employed. A snugly fitting firm rubber tube is passed through the cannula and is hermetically sealed to the chest wall by strips of rubber adhesive, heated before being applied.

A rubber tube is preferable to a catheter because the inner diameter is greater. The tube is then joined by a glass connection to a tube leading to a Winchester suspended under the bed and half full of an antiseptic solution to which a deodorant has been added (Fig. 5). The fluid should not be allowed to escape through the cannula before the tube is inserted and is led off to a bottle because it is difficult to determine the level of the fluid in the chest or the amount present, and air may accidentally be allowed to enter the cavity and collapse a lung that has been expanding following the removal of the fluid by aspiration.

In addition, with the tube led into the fluid and a clamp on it, the fluid can be allowed to escape slowly and without the danger of producing sudden syncope which is alarming if not fatal.

If the fluid is so thick that it will scarcely run through the tube, a second small tube may be inserted in the highest space of the cavity, and the cavity then irrigated two hourly by day and four hourly by night through the upper catheter, emptying through the lower one.

As soon as the patient recovers from the manipulation and movement necessary to insert the tube, forced blowing exercises are begun every hour by the use of large Wolfe bottles (1 to 5 gallons) and are constantly urged on the patient by all in attendance.

As the tract about the tube enlarges, a larger tube is inserted, and if the temperature is still maintained and the cavity ceases to reduce appreciably, two or three small Carrel tubes carried on pliable lead are inserted through the opening and placed in the upper portion of the cavity, and routine Carrel-Dakin treatment is begun (Fig. 6). A surgical solution of chlorinated soda (Dakin's solution) is used, except when a bronchial fistula is present or there is evidence of bleeding

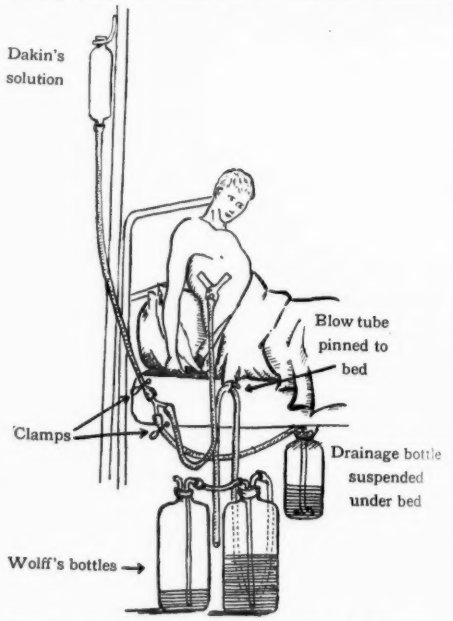


Fig. 5. Armamentarium for treatment of empyema.

from within the cavity. Then saline only is used or irrigations are stopped for a few days. An inverted Y tube is employed that leads to a container with the irrigating fluid in it, suspended above the bed and to the Winchester under the bed for drainage. Adult patients are trained to handle the clamps and irrigate themselves.

If the patient is still not doing as well as is expected, the tract of the tube is cauterized, excised, and the incision is extended either way and the thorax widely opened in the interspace. The cavity is thoroughly irrigated, explored with a lighted retractor, adhesions severed, fibrinous deposit cleared out manually, and all encysted or non-dependent cavities rendered dependent. If the pleura at the junction of the visceral and parietal reflection is greatly thickened, it is partially stripped so as to allow the lung to expand. A bronchial fistula, if present, is cauterized and partially sutured. Carrel tubes on lead carriers are placed about the upper walls of the cavity and irrigation with Dakin's solution carried out as previously indicated.

RIB RESECTION IF NECESSARY

Should there be any difficulty in gaining and maintaining easy access to the cavity through an interspace, we do not hesitate to resect a rib widely, being careful to have our opening at the lowest portion of the cavity. Osteomyelitis is almost completely avoided if bone wax is well rubbed into the cut surfaces before they become contaminated. This is important. Occasionally, after first opening the chest in the interspace and finding that the incision is not dependently placed, it is necessary to insert the hand and make an opening in a lower space directly on the fingers pressed against the space. In such an instance, the upper incision is usually closed completely, the Carrel tubes brought out through the lower opening, and the Carrel-Dakin treatment carried on.

Many ingenious methods have been devised for maintaining closed drainage, with suction, tidal irrigation, and what not. All these methods are extremely valuable and have served to direct greater care and attention to the unfortunate victims of this grave disease. Some of the devices are somewhat cumbersome for the ordinary general surgeon to set up and supervise. In the hands of their exponents and followers marvellous results are continually being reported. These men should be encouraged in any effort they make to reduce mortality and avoid the development of chronic empyema. Those of us engaged in the practise of general surgery must, however, I believe plan a simple workable method such as I have outlined, and perfect it in so far as it is feasible. With such a method uncomplicated acute empyema should carry practically no mortality, and chronic empyema should almost disappear as a surgical entity.

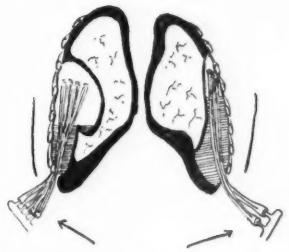


Fig. 6. Arrows indicate position of tubes containing lead wire.

ENCAPSULATED EMPYEMA

Encapsulated empyema and particularly intralobar empyema should be treated conservatively and with the greatest of care. If aspiration is undertaken it should be done under the fluoroscope and if pus is located the cavity should be emptied with a syringe, irrigated carefully with saline and 1 ounce of 2 per cent formalin in glycerin may be left in. Many of these small encapsulated collections may be cleared up in this way without further interference. In doing an aspiration in encapsulated empyema great care must be taken to avoid infecting the pleural cavity, with the subsequent development of a general empyema, or of puncturing the lung unnecessarily, thereby carrying in infection and possibly lighting up a lung abscess. Moreover, even in encapsulated empyema, trocar and cannula drainage may be employed and incision and drainage may be reserved for a last resort.

BILATERAL EMPYEMA

Bilateral empyema is a serious complication and requires care and judgment to prevent death. Aspiration of the most seriously involved side should be employed first and aspiration of the other side should be delayed if possible for 2 or 3 days. Trocar and cannula drainage should be delayed until the pus is frankly purulent, and in all measures for the establishment of drainage of the side with the largest effusion should be dealt with first. Especial care must be taken to avoid a pneumothorax in the early stage of the disease. Bilateral drainage at one operation should never be undertaken in my opinion. Otherwise the routine outlined for unilateral empyema applies to the bilateral type.

TREATMENT OF ACUTE EMPYEMA IN CHILDREN

Children do not tolerate empyema nor the treatment of it as well as adults. The highest incidence of the disease is during the second year. It declines from the second to the eighth or ninth years. The highest mortality is in the second year, because the disease is rare in the first year. The treatment in general is almost the same in adults and children, but children respond even better to closed drainage than do adults. They do not co-operate as well as adults in permitting repeated aspirations or closed drainage. Carrel-Dakin's treatment cannot be carried out so efficiently. If they are hospitalized, however, every effort should be made to deal with the condition by closed drainage and suction. Otherwise it is safer to resort to incision and drainage early after preliminary aspirations and a short period of closed drainage. The mortality is still high in children varying in reported cases from 50 per cent to 5 per cent. Chronic empyema in children, except where the disease has been overlooked for months or is due to tuberculosis, should never occur.

ANÆSTHESIA

Local anæsthesia (Menges' solution—novocain 1 per cent; potassium .025 per cent in normal saline, to which 5 to 8 drops of adrenalin chloride is added to each ounce just before use) and a modified paravertebral anæsthesia, if necessary, associated with gas and oxygen analgesia, is employed for all operative measures during the acute stage of the disease.

BLOOD PRESSURE

The blood pressure is carefully checked during all procedures in the chest. A systolic pressure of 90 is dangerously low because, as Sauerbruch has pointed out, an open pneumothorax produces a loss of body heat equal to or greater than that following a laparotomy. Disturbances of respiration and circulation as well have a tendency to lower the blood pressure. The blood pressure invariably falls 15 to 30 points as a result of an open operation, and if care is not taken to maintain the blood pressure to at least 100 during the operation, the patient may pass into a stage of shock following the subsequent fall. Ephedrine should be given hypodermically. Bandaging the lower extremities, intravenous saline or glucose, and blood transfusion if necessary, should be employed. The thorax should be opened in an operating room in which the temperature is maintained at approximately 80 degrees.

CARE OF THE PATIENT ON THE OPERATING TABLE

If the patient is particularly dyspnœic he should be placed on the operating table in the position in which he can breathe most comfortably, and should be maintained in that position during the operation, particularly if a gas-oxygen analgesia is associated with the local anæsthesia. During the course of the operation the patient should not be rolled about from side to side in an endeavor to drain or irrigate the cavity. Such movements have a tendency to lower the blood pressure. It is equally important that the patient on being returned to bed, should be put in the most comfortable position to permit of free breathing.

TREATMENT SHOULD BE CONSERVATIVE

Conservative and palliative measures should be adopted in the treatment of acute empyema. Treatment should be planned to avoid pneumothorax in the acute stage of the disease with underlying lung involvement; the general nutrition should be maintained in so far as is

possible; the fluid should be withdrawn at the opportune moment, and early sterilization and obliteration of the cavity should be the aim. In patients with large cavities there is a diminution in the air-bearing capacity of the lungs, and every effort should be made to re-expand the collapsed lung without undue delay with a view to restoring the normal vital capacity.

When operation is considered necessary it should be sufficiently radical to allow free exploration of the cavity so that retained pockets may not be missed and a mediastinal or intralobar collection overlooked. In a fair percentage of patients with a pneumococcal collection we have been able to close the incision at once after thoroughly clearing out the cavity and by aspirating the cavity at the end of 18 hours, 36 hours, and 60 hours, have had the lung in complete expansion by the fifth or sixth day. This should not be considered with streptococcal empyema. Repeated short operations within the safe limits of the patient's resistance reflect the sound judgment of the surgeon.

A combination of aspiration, closed drainage, Carrel-Dakin treatment through the tube and later if necessary, incision plus Carrel-Dakin treatment has reduced our mortality considerably, and has practically done away with chronic empyema entirely. Eight to 10 per cent have been cured by aspirations only, and 70 per cent have been cured by aspirations plus trocar and cannula drainage and Carrel-Dakin treatment. Approximately one in three or four of this latter group have required a minor surgical procedure to hasten closure of a small residual cavity or fistula that contained a few drams on measurement. Approximately 5 per cent of the acute cases have required an intercostal incision or rib resection to permit us to deal with adhesions or residual pockets. Forty-two days have been the average for the complete obliteration of an acute empyema. Not more than 2 to 4 per cent have gone on to the chronic stage of the disease. Bronchial fistulæ—a massive type of cavity lying in the vertebral gutter, an apical or axillary cavity—have contributed to the incidence of chronic empyema in our series of cases.

Our mortality has averaged 12 per cent in the acute stage of the disease but this included a high percentage of acute empyemata due to streptococcal infection during the influenza epidemic. For 8 years we have not had a death in uncomplicated acute empyema and 2 per cent only have gone on to the chronic stage of the disease.

The Empyema Commission reported as high as 13 per cent cured by aspirations only. Mozingo reported 138 cases treated in 1918 by the closed suction method with a mortality of less than 2 per cent. Heuer reported 221 patients treated by drainage and no special postoperative treatment with a mortality of 20 per cent and 50 cases treated by Carrel-Dakin's method with the very low mortality of 4 per cent. He reported that for 4 years he did not have a chronic empyema develop. Flint and Douglas reported 102 cases treated in the Yale Clinic at New Haven without a case of chronic empyema ensuing. Graham reported 1 death in 36 children, 2.77 per cent treated by preliminary aspiration and drainage later. Douglas reported 48 patients, mostly children treated by aspirations and suction drainage with only 4 deaths. McKenna reported 19 adult patients treated by aspirations and trocar and cannula drainage without a death. Hart reported 35 patients treated by his method of tidal irrigation with 6 deaths. These 6 had "overwhelming infections" and grave complications. The average time of obliteration of the cavity to 5 cubic centimeters was 21 days in his group.

Surely these gratifying results justify the extreme care, close co-operation and attention that has been found necessary in the treatment of the disease in the last decade.

REFERENCES

1. Douglas, Beverley. Empyema in infancy and childhood. Ann. Surg., 1930, May, 665.
2. Flint and Douglas. Quoted by Heuer, loc. cit.
3. Graham, E. A. Abt's Pediatrics. Vol. iv, p. 123. Philadelphia: W. B. Saunders Company.
4. Hart, Deryl. Empyema. Arch. Surg., 1929, December, 1765.
5. Heuer, George J. Empyema of the pleural cavity. Ann. Surg., 1925, December, 715.
6. McKenna, H. Operations for empyema. J. Am. M. Ass., 1918, p. 743.
7. Mozingo, A. E. Treatment of empyema by closed method. Mil. Surgeon, 1921, xlix, 89.

THE ETIOLOGY AND TREATMENT OF PULMONARY ABSCESS[1]

GEORGE J. HEUER, M.D., F.A.C.S., Cincinnati, Ohio

I PROPOSE to confine my discussion of the etiology and treatment of pulmonary abscess to the common form of abscess in which surgeons of late years have been so interested and about which so much has been written recently. I shall not attempt to discuss the tuberculous abscess of the lung, the abscesses associated with primary bronchiectasis, and the rarer forms of abscesses complicating mycotic diseases, actinomycosis, blastomycosis, and streptothricosis.

ETIOLOGY

1. *The varying clinical and pathological manifestations of pulmonary abscess.* One of the sources of confusion in a clear understanding of the etiology of abscess has been the proper interpretation of the various lesions which occur. In any large individual or collected series of cases of pulmonary abscess, abscesses of various sorts are observed. Clinically one sees abscesses the symptoms of which are sudden, severe, and fulminating; others in which they are insidious and comparatively mild. Physical signs may indicate a spreading or a local lesion. Clinically in some (the majority) the sputum is foul and brownish or greenish in color; in others it is without odor and mucopurulent in character. Culturally and by smears all recent studies have shown that the sputum in 70 per cent or 75 per cent of the cases contains predominantly the anaerobic organisms common to the mouth; in others, various pyogenic organisms. At operation and at necropsy the lesion may be a localized area of suppuration without odor and with or without a limiting fibrous wall depending upon its age; or a localized malodorous area of destruction with liquefaction, the tissue surrounding which is ragged, brownish or greenish and suggests gangrene; or a spreading area of gangrenous destruction with early and frequent extension to the pleura with the development of empyema. In the first pathological type Kline and Berger find in sections stained for organisms that clusters of staphylococci in the finer bronchial ramifications and alveoli constitute the predominant organisms; in the 2 last types they and Lambert and Weeks find the oral spirochætæ to be the predominant organisms in the advancing zone of necrosis. In some cases bronchial dilatation is quite a prominent feature of the condition as may be demonstrated by lipiodol injections and at necropsy; in others it is inconspicuous or absent. While clinically and pathologically pulmonary abscess may show these various manifestations, the predominant type is an abscess, usually single, which tends to limit itself from the beginning and which eventually becomes limited by a fibrous wall.

Experimentally the lesions produced in laboratory animals (rats, guinea pigs, rabbits, dogs) also have varied. The pathological and bacteriological findings in the lesions produced by various workers using various methods and various organisms are often not accurately described and one is left in doubt as to the exact nature of the lesion. But it would appear that pneumonitis, bronchopneumonia, abscess, gangrene, and bronchiectasis have all been produced. Although it is hazardous to do so because of the lack of accurate data I should say that speaking generally of the work of many investigators, the predominant lesion produced by aspiratory and embolic methods with oral anaerobes is of the nature of a pulmonary gangrene; by embolic methods with pyogenic organisms is an abscess which is characterized by a tendency rapidly to heal. Neither exactly resembles the common abscess in man.

In view of these clinical and experimental findings the questions have naturally arisen: Are the various clinical varieties of lesion seen in the human subject distinct conditions or one and the same condition but modified by various factors? Are the various experimental lesions which have been produced distinct conditions or varying manifestations of one condition? And, are the experimental

[1]Presented before the Clinical Congress of the American College of Surgeons, Philadelphia, October 13–17, 1930.

lesions comparable to those seen in man? These questions cannot all be positively answered. Certain observers (Kline and Berger and others) differentiate sharply between gangrene and abscess in man; others (D. T. Smith, 32, etc.) strongly suggest that the various conditions are different manifestations of the same disease. Evidence for this latter view is accumulating. Clinically, the multiplicity of lesions, including various forms of bronchitis, bronchopneumonia, abscess, gangrene and bronchiectasis, seen in spirochætal infections of the lung; the occurrence of two or more lesions in the same individual as abscess and gangrene, abscess and bronchiectasis, pneumonia, and abscess, and so forth in other pulmonary infections; and the analogy of the various manifestations of the same infection in tissues other than the lung, all suggest the idea of one condition modified by various factors. Experimentally various lesions including pulmonary abscess, pulmonary gangrene, and bronchiectasis have been produced in rabbits by one investigator using exactly the same method and the same organisms (D. T. Smith, 32). The variations in the lesions produced in dogs by different investigators using different methods and different organisms cannot yet be satisfactorily explained but it is possible they depend on the virulence of the organisms used, the method, and the animal. Until these variations are more satisfactorily explained one cannot say definitely that the lesions are entirely comparable to those in man.

The common clinical conditions antedating pulmonary abscess. A study of the circumstances which have immediately antedated the development of pulmonary abscess has thrown much light of a clinical nature upon its mode of production and has stimulated important experimental investigations bearing upon its etiology. These antecedent conditions are wounds of the lung; the acute respiratory infections including the pneumonias; the aspiration of metallic and other foreign bodies; malignant disease of the œsophagus, bronchi, and lungs; certain acute surgical infections associated with septicæmia; certain other acute surgical conditions as peritonitis, hepatic and subphrenic abscess; and, finally, surgical operations. Of these, surgical operations are at present the cause of the greatest number of pulmonary abscesses but it should be remembered that this is true not because the percentage incidence of abscess following surgical operations is greater than following the other conditions I have mentioned, but because so great a number of operations are performed. So nearly as I can determine from a review of the literature, pulmonary abscess following wounds of the lung, the pneumonias, and the aspiration of foreign bodies occur in about 1 per cent of the cases; a figure higher than that following surgical operations. Various surgical operations are followed by pulmonary abscess. These are tonsillectomy; other operations about the mouth as the extraction of teeth and procedures upon the tongue and lip; abdominal operations and, particularly, upper abdominal operations; operations presumably aseptic as those for hernia and goiter; and operations for septic conditions as mastoiditis, peritonitis, and hepatic and subphrenic abscess.

The mode of entrance of the infecting organisms into the lung. From a study of these antecedent conditions, pulmonary abscess in man apparently may arise by the direct implantation of infecting organisms into the lung as in wounds; by inhalation or aspiration as in pneumonia, foreign bodies and surgical operations; by septic embolism as in surgical operations and septicæmia; and by lymphatic extension as in peritonitis, subphrenic and hepatic abscess. Clinically it would appear that organisms may gain entrance into the lung and cause abscess in these four ways; and in any consideration of the prevention of pulmonary abscess, due consideration should be given each of them. The chief interest in the matter has, however, centered about aspiration and septic embolism, and largely because these two modes of entrance of infecting organisms into the lung are concerned in the production of postoperative pulmonary abscess. A great amount of experimental work has been done by Cutler and his associates, Holman, Allen, Hedblom (14), Van Allen, Crowe and Scarff, Kline and others, to determine which mode, aspiration or septic embolism, is predominantly the usual mode of

entrance in man. The results of this work have been to align one group of investigators upon the side of aspiration and another upon the side of septic embolism. A third group straddles the question and brings evidence to prove that both septic embolism and aspiration play a part; the former by initiating the abscess, the latter by increasing the severity of the process and the tendency to chronicity.

You must be familiar with the arguments, based upon both clinical and experimental observation of the proponents of the embolic and aspiration theories. They have been repeatedly and well presented in the communications upon the subject by Cutler, Schleuter, Weidlein, Holman, Fetterolf and Fox, Hedblom (14), Joannides, Van Allen, and others. An excellent résumé of the subject appears in a recent article by B. S. Kline. When one studies the clinical and experimental data thus far available in an attempt to discover which method, aspiration or septic embolism, is the important and common method of infection in man, he finds himself in difficulties. It will be impossible within the limits of this paper to discuss the more recently accumulated experimental data bearing upon this question. Concentrated into a series of statements—a dangerous procedure because of the probability of misinterpretation—the matter appears at present to be as follows: (a) The clinical arguments cited by the adherents of the embolic and aspiration theories are often unsatisfactory. An important clinical argument in favor of the embolic theory may quite readily be interpreted in favor of the aspiration theory; and the reverse is also true. (b) Experimentally both the embolists and the aspirationists have produced a pulmonary lesion by their favorite method. These lesions vary according to the method and organisms used. By the embolic method using aerobic pyogenic organisms, single or multiple abscesses are produced which show a tendency rapidly to heal. (Cutler and associates, Van Allen, etc.) The multiple abscesses rather resemble the septicæmic abscesses in man. By the same method using *oral anaerobes* as the infecting organisms, pulmonary lesions are produced which consist of a central necrotic area containing a green foul-smelling exudate and surrounded by a zone containing spirochætæ (Lambert and Weeks, Herrmann and Cutler); a lesion which Kline would probably call pulmonary gangrene. By the aspiration method I know of no series of clean cut experiments in which aerobic pyogenic organisms alone, simply introduced into the bronchi have produced an abscess from which these organisms have been recovered. By the aspiration method using oral spirochætæ a series of lesions including pulmonary abscess, pulmonary gangrene and bronchiectasis has been produced in the rabbit (D. T. Smith, 32). By the same method with the same organisms Hedblom (14) produced in dogs a lesion, inaccurately described, but which suggests to me a pulmonary gangrene. He found that the lesions were more readily produced when oral anaerobes were mixed in fresh dogs' blood. Allen, Van Allen, and Crowe and Scarff found it very difficult to produce lesions resembling abscess in dogs by aspiration alone with oral spirochætæ; but when deliberate bronchial obstruction was added to aspiration, lesions were readily produced in these animals. (Allen, Crowe and Scarff.) The lesion produced by Crowe and Scarff is accurately described and in its destructiveness and its rapid spread to the pleura with the invariable production of empyema it resembles the pulmonary gangrene described by Kline and Berger in man.

The variations in the experimental results obtained by either the aspiration or embolic method and their presumed failure to explain the common abscess in man, led Van Allen to test experimentally the hypothesis that both methods, embolism and aspiration, play a part in the production of pulmonary abscess. According to this theory the primary event is a pyogenic abscess produced by septic embolism, the secondary event is the invasion by aspiration of organisms common to the mouth. He first introduced septic emboli, opaque to the X-ray and containing pyogenic organisms, into a vein and 10 days later injected organisms from a human abscess into the bronchus nearest the point of lodgement of the embolus. He readily produced abscesses in dogs larger than those produced by septic emboli alone and showing a greater bent to chronicity.

Thus, the experimental work undertaken largely to determine the usual mode of infection in man has resulted up to the present time in the production of lesions both by aspiration, by embolism, and by their combinations. These lesions vary and although not always accurately described they suggest bronchopneumonia, pulmonary abscess, pulmonary gangrene, and (in rabbits) bronchiectasis. In variability they suggest the conditions seen in man. Their relationship in the dog has not been demonstrated but in the rabbit a relationship seems possible since all conditions were apparently produced by the same organisms. Which mode of infection—aspiration or embolism—is the usual mode in man has not been established by these experiments. But other observations bearing upon the kinds of infecting organisms found in pulmonary abscess and their causal relationship to the disease, have shed additional light upon the subject and of these I shall next speak.

The kinds of infecting organisms found in and their causal relationship to pulmonary abscess. The literature on the bacterial flora of early pulmonary abscess in man is meager but all recent reports upon the bacterial flora of chronic non-tuberculous pulmonary suppuration show the predominance of oral anaerobes in the sputum. Varney, in 21 cases of chronic, untreated pulmonary abscess found that the bacillus melaninogenicum, bacillus fusiformis, and spirochætæ were the predominating organisms, although the streptococcus viridans was predominant in 5 cases. The streptococcus hæmolyticus while always present was never in any numbers. In 6 patients improving after treatment by operation the striking change in the bacterial flora as contrasted with the untreated cases was the diminution in the number or the disappearance of the bacillus melaninogenicum, bacillus fusiformis, spirochætæ, and streptococcus viridans coincident with a relative increase in the number of streptococcus hæmolyticus. In over 70 per cent of cases of chronic untreated pulmonary abscess, therefore, oral anaerobes and cocci occurred together. D. T. Smith (33) found spirochætæ, fusiform bacilli and cocci in 82 per cent of his cases of bronchiectasis and the same organisms including vibrios almost constantly in the so-called bronchopulmonary spirochætosis (34). Other careful studies have shown the frequent presence and association of these organisms in chronic non-tuberculous pulmonary suppuration. The frequent presence of these organisms suggests to some observers a direct causal relationship to the abscesses in which they are found, to others the rôle of secondary invaders. Not only does the question of direct causal relationship arise, but the question whether, if they are the direct causal agent, any one of them or several growing in intimate symbiosis is the particular cause of abscess. It was stated in preceding pages that a number of investigators produced pulmonary lesions by the introduction of oral anaerobes into the bronchi. The infecting medium, however, was in many experiments sputum from human abscesses which contained a variety of organisms. Lambert and Weeks refined the experiments in that they used anaerobes alone as the infecting organisms. Using the embolic method so as to avoid contamination with other organisms they produced single, discrete lesions with a central necrotic area containing a green, foul-smelling exudate and surrounded by a zone containing spirochætæ. They conclude that the anaerobes are not simply secondary invaders but can and do of themselves give rise to pulmonary suppuration. D. T. Smith (35) refined the experiment still further by using pure cultures of the organisms as the infecting agents. He was able to isolate in pure culture the spirochæta macrodentium, the spirochæta microdentium, two types of fusiform bacillus, four strains of vibrios and anaerobic cocci. These organisms were injected into the bronchi of rabbits and caused a variety of lesions including abscess, gangrene, and bronchiectasis. These experiments, to which should be added those of Kline, offer strong evidence that oral anaerobes are the cause of many pulmonary lesions.

Certain other observations pertain to the question whether individual organisms of this group are specific or whether they act in symbiosis in the production of abscess. Smith (36) was unable to produce pulmonary abscess in rabbits by the intratracheal injection

of pure culture of spirochætæs. Scarff concludes that spirochætæ are not essential to the production of pulmonary abscess in dogs. Tunnicliff was unable to produce suppuration with pure strains of spirochætæ isolated from a severe case of Vincent's angina. Kline in transferring a mixed infection derived from the mouth from animal to animal (guinea pigs) down to the thirty-sixth passage found that the spirochætæ disappeared after the twelfth passage although the virulence and destructive nature of the infection increased. These observations all have to do with the spirochætæ as specific organisms. D. T. Smith (35) extended the observations. Using the groin as the site of infection and mice and guinea pigs as the experimental animals he injected separately and then in various combinations pure cultures of anaerobic organisms. He found that the spirochæta microdentium, and the large and small fusiform bacillus, injected separately, failed to produce a lesion in mice or guinea pigs. The vibrio produced in both animals a hard, indurated lesion with little or no pus. The anaerobic hæmolytic streptococcus produced a red cellulitis from which the animals died or completely recovered. In mixtures the spirochæta microdentium and large and small fusiform bacilli failed to produce an infection. A mixture of the vibrio and anaerobic hæmolytic streptococcus produced a more severe lesion than either organism alone but the lesion did not present necrosis or odor. Other mixtures and their results need not here be recorded but finally when a mixture of spirochæta microdentium, vibrio, small fusiform bacillus and anaerobic hæmolytic streptococcus was used a large, necrotic, foul smelling abscess was produced which could be transmitted from guinea pig to guinea pig. The pus from one of these abscesses was inoculated into the trachea of four rabbits and produced a variety of suppurative pulmonary lesions as previously noted. These experiments certainly suggest that these organisms growing in symbiosis produce suppurative lesions rather than single organisms. In a more recent study, Smith (33) found that when 22 rabbits were innoculated intrabronchially with these organisms 8 died of pulmonary abscess, 7 died of pulmonary gangrene, 5 developed bronchiectasis and 2 recovered completely. The experience suggests in view of the experiments I have just quoted not only that oral anaerobes act in combination in the production of pulmonary suppuration but that different combinations of them may produce abscess or gangrene or bronchiectasis. Following his lead Hermann and Cutler, using the embolic method, have applied the experiments of Smith to the dog. They proved that pure cultures of spirochæta microdentium and large and small fusiform bacilli when implanted in pulmonary tissue failed to produce a pulmonary lesion; but that several combinations of anaerobic organisms produced lesions which more closely resembled the chronic abscess seen in man. They do not state the combinations used.

There remains to discuss the group of pulmonary abscesses, comprising 25 to 30 per cent of the total number, in which oral anaerobes are not the predominating organisms in the sputum. In these, more information pertaining to the relationship between the organisms and the abscess is desirable. In smears and in cultures the organisms are chiefly the pyogenic cocci; and a causal relationship is suggested by the finding that in microscopic sections of odorless suppurative lesions stained for bacteria, pyogenic cocci may be the predominant organisms in the finer bronchi and alveoli. In the multiple septicæmic or pyogenic abscesses of embolic origin in man this relationship seems definite; but these do not represent the common abscess in man. Experimentally abscesses, single and multiple, may be produced with aerobic pyogenic cocci by the embolic method. So far as I can determine they differ from the common abscess in man chiefly in that, proportionately, they are more often multiple and that they tend more rapidly to heal. They lack chronicity which thus far has been furnished experimentally only by the use of different organisms, the oral anaerobes. The discrete chronic abscess in man in which pyogenic cocci are the predominant organisms still requires explanation. Are they varieties of aspiration or embolic abscesses from which oral anaerobes have disappeared? The ob-

servations of Varney upon the comparative bacterial flora of untreated and treated abscess may bear upon this question.

The rôle of other factors in the production of abscess. The ease with which organisms may enter the bronchi from the nasal and oral cavities has been shown by Iglauer, Daly and Daly, Myerson, Ochsner and Nesbit, Singer, and others. Yet the incidence of abscess is low. So too, in wounds of the lung, in pneumonia and in aspirated foreign bodies the incidence of abscess, when one considers the favorable conditions for its production, seems very low. It is suggested by various clinical and experimental observations that aspirated organisms are rapidly eliminated by cough, ciliary action, and bronchial peristalsis (Myerson, Hedblom, etc.); but other experimental work indicates that fluids, if not too viscid, gravitate immediately to the periphery of the lung beyond the reach of an expelling cough or ciliary action. (Hoelscher, Mullin and Ryder, Corper, and Archibald.) Clinical experience suggests that mere contact of organisms with the bronchi and lungs is not sufficient to explain pulmonary abscess in man and that other factors play a part in its production. These include the virulence—resistance ratio, the interference with the blood supply of the lung and bronchial obstruction.

Virulence—resistance ratio. The evidence of the importance of this factor may briefly be mentioned. The virulence of the organisms on the one hand and the resistance of the host, either general or local, on the other is known to be an important factor in many infectious processes and there is no reason to suppose that it does not influence the production and the severity of suppurative processes in the lungs. The fact that pulmonary abscess so rarely occurs, the striking differences in the severity of symptoms, size and number of abscesses in different human individuals, the differences in the ease of producing abscess by aspiration methods in different experimental animals, the rarity of abscess in war wounds of the lung in comparison with the frequency of serious infections in other tissues, and the rarity of abscess in aspirated foreign bodies, all suggest that this factor may play a rôle in the production of pulmonary abscess. There is little experimental work bearing directly on this point. The work of Crowe and Scarff suggests that the virulence of the infecting organisms may play a part in the kind of lesion produced. By incubating the organisms for a period of weeks in the frontal sinus of dogs before introducing them into a bronchus, they apparently produced highly virulent organisms; for the rapid spread of the lesions produced, their destructiveness and the invariable involvement of the pleura, all indicate a highly virulent infection. Certain experiments of Van Allen also suggest this.

Interference with the blood supply of the lung. The unusual vascular supply of the lung may account for the vitality and the apparent resistance of the lung to infection. Experimentally Van Allen has tested the effect of occlusion of a branch of the pulmonary artery upon the ease of producing pulmonary lesions by aspiration. Bland or aseptic emboli (small bird shot) were first introduced into the external jugular vein, the location of which in the lung could be determined by X-ray. Having determined the location, organisms from the sputum newly obtained from patients with chronic pulmonary suppuration were injected into the bronchus which supplied the embolized lobe. The procedure resulted in a variety of lesions including massive gangrene, solitary abscess formation and septic infarct which Van Allen believes may be interpreted on the basis of alterations in tissue vitality. He finds that these lesions are different from those produced by septic emboli alone in that the latter lack infarct distribution. He suggests that the combination of bland infarct and aspiration of organisms may explain the postoperative pulmonary abscesses following strictly aseptic or sterile operations. He concludes that the greater vitality of the lung and its resistance to infection is due mainly to its greater blood supply. In view of the variety of lesions produced by aspiratory methods alone without the factor of deliberate vascular occlusion, Van Allen's experiments are not altogether convincing. In septic embolic abscesses the factor of vascular occlusion may well play a part in the process; in aspiratory

abscesses vascular occlusion must be a part of the inflammatory process through thrombosis. Whether the latter is remarkable in comparison with thrombosis in other infections has not so far as I know been determined.

The rôle of *bronchial obstruction* in the production of pulmonary abscess has been emphasized by Allen and Crowe and Scarff, who, like many before them, had been unable to produce pulmonary abscess by aspiration until they occluded a bronchus proximal to the infecting medium. Scarff believes that obstruction is essential to the production of abscess by aspiration and must persist for over 4 days; for if the obstruction is relieved by coughing up the obstructing mass before the fourth day of the experiment the animal completely recovers without the development of pulmonary abscess. Hedblom, since the experiments of Allen and Crowe and Scarff, was able to produce pulmonary abscess by aspiration without deliberate bronchial obstruction and emphasizes the importance of abolishing the cough reflex sufficiently long to allow infected fluids to settle in the alveoli. But he may well have produced obstruction of smaller bronchi by blood clots for he states that abscess was most frequently produced when fresh dog blood mixed with sputum from a human abscess was injected into a bronchus. Clinically the factor of obstruction in the occurrence and severity of infections generally has long been known and its importance appreciated; as, for example, the obstruction of the cystic duct by stone in infections of the gall bladder. With respect to the lung we have better appreciated this factor since our attention has been called to the not infrequent occurrence of partial and massive collapse of the lung through obstruction of bronchi by plugs of mucus. It may be that mucous plugs or clots obstructing the smaller bronchi over a fairly prolonged interval are of great importance in the production of pulmonary abscess in man.

To summarize this part of my paper I may say:

1. Clinically pulmonary abscess includes a variety of conditions which present sometimes the features of abscess, sometimes those of gangrene, and sometimes those of bronchiectasis. When the lesion is single, discrete, and encapsulated we speak confidently of the condition as pulmonary abscess; when otherwise we are often in doubt as to the nature of the lesion, one evidence of which is our use of the inclusive term chronic, non-tuberculous pulmonary suppuration.

2. Experimentally by the use of either aspiratory, septic embolic, or combined aspiratory and embolic methods a variety of lesions has also been produced which resemble bronchopneumonia, abscess, gangrene, and (in rabbits) bronchiectasis. To some investigators the various lesions occurring in man and, experimentally, in animals suggest different manifestations of one disease process; to others, the variety of experimental lesions produced represents a failure to produce with any regularity the common abscess in man.

3. Clinically the sputum in 75 per cent of cases of pulmonary abscess, 80 per cent of cases of bronchiectasis, and practically 100 per cent of cases of spirochætal gangrene contains predominantly the anaerobic organisms found in the mouth of 80 per cent of all individuals. In the remaining 25 per cent of cases of pulmonary abscess, the sputum contains predominantly varieties of pyogenic cocci.

4. The causal relationship between oral anaerobes and certain pulmonary lesions including abscess is indicated by the frequent presence of these organisms in human sputum and human abscesses and by the experimental production of these lesions by aspiratory or embolic methods with pure cultures of these organisms. Experimentally these organisms appear to act in symbiosis in the production of abscess. These experiments speak against the theory that they are merely secondary invaders.

5. The causal relationship between pyogenic cocci and certain other pulmonary abscesses seems definite in the septicæmic or pyæmic abscesses in man. In animals it is established in the single and multiple abscesses produced by the embolic method. In the so-called pyogenic abscesses in man (the 25 per cent of cases in which the sputum contains predominantly the pyogenic cocci) it is thus far not established. It is possible that

these represent aspiratory abscesses from which anaerobic organisms have disappeared.

6. The importance of oral anaerobes in the causation of pulmonary suppuration strengthens the position of those who hold that pulmonary abscess more commonly occurs as the result of the aspiration of organisms into the bronchi and lung. The observations that 75 per cent of human abscesses contain predominantly the anaerobic organisms common to the mouth; that these are not secondary invaders but do when introduced in pure culture into the bronchi of various experimental animals, produce pulmonary lesions, including abscess, from which those organisms are recovered are particularly suggestive. The importance of these organisms in the causation of bronchiectasis and spirochætal pulmonary gangrene makes it appear necessary to include these conditions in the problem. It would seem to me more desirable at the moment to concentrate upon the experimental production of specific lesions rather than upon the aspiratory or embolic methods of producing them. Especially is this true since we are aware of the importance of both methods and may apply such measures as we know toward the prevention of infection by either.

7. The experimental production consistently or with regularity of an abscess which resembles the common abscess in man has not yet been reported. The production of different lesions including abscess by different mixtures of the same organisms in the groin of experimental animals (D. T. Smith) suggests the possibility of producing consistently definite lesions in the lung. Work is evidently progressing along these lines.

8. The importance of various factors as the virulence, resistance ratio, the blood supply of the lung, and bronchial obstruction in the production of pulmonary abscess must be apparent in view of the ease and frequency of innoculation and the rarity of abscess.

THE PREVENTION OF PULMONARY ABSCESS

In view of the relationship between organisms common to the mouth and septic embolism to pulmonary abscess, one should, before discussing the treatment of pulmonary abscess, consider the matter of its prevention. Certain obvious things may be done in the hope of lowering the incidence of postoperative abscess, some of which may be helpful in the prevention of pulmonary suppuration generally. These I may state as follows:

1. In all operations, whether about the nose, nasal sinuses, mouth and throat, or elsewhere, careful and systematic nasal and oral hygiene should be carried out, if possible for some time before operation.

2. In all operations about the nose, mouth, and throat, whether done under general or local anæsthesia, great care should be exercised in hæmostasis and in measures to remove blood and mucus from the pharynx. The ease and frequency of bronchial contamination and the possible importance of obstructive agents as blood clots and mucous plugs as causative factors in the production of abscess have been referred to.

3. In all operations careful aseptic technique, the careful handling of tissues, the avoidance so far as possible of the ligation of large masses of tissue are of themselves essential to all proper surgery, but they may have an added importance in view of the relationship between septic emboli and pulmonary abscess.

4. The frequent turning of the patient, pulmonary gymnastics, the encouragement of cough, and the overventilation of the lungs with carbon dioxide following operation suggest themselves as preventive measures if one favors the aspiration theory of abscess and is mindful of the possible importance of stasis or bronchial obstruction in the causation of abscess. If one happens to favor the embolic theory these measures in certain cases may be contra-indicated; for as abscess is particularly liable to follow upper abdominal operations and is presumed to be due to the dislodgement of infected emboli, the reverse of these measures—the fixation of the lower chest and upper abdomen—may seem more desirable and has actually been advocated.

5. Prompt removal of foreign bodies from the bronchi, and, in cases in which operation is indicated, the removal of foreign bodies if possible in wounds of the lung. Both clinically and experimentally it is the foreign body

which produces bronchial obstruction over a considerable period of time which is associated with pulmonary abscess.

6. The prompt recognition, if possible, and the proper treatment of such acute conditions as mastoiditis and osteomyelitis which give rise to septicæmia and, secondarily, to embolic pulmonary abscess; and conditions as peritonitis, hepatic and subphrenic abscess which may give rise to the occasional pulmonary abscess by lymphatic extension.

THE TREATMENT OF PULMONARY ABSCESS

In the treatment of pulmonary abscess the establishment of free drainage constitutes one of the most important if not the most important measure in its cure. The primary treatment of pulmonary abscess in its early stages is the establishment of drainage. It may be non-surgical or surgical. In view of the favorable results obtained by non-surgical drainage, few observers now advocate early operation for early uncomplicated pulmonary abscess. Non-surgical drainage may be secured in two chief ways—by postural drainage and by bronchoscopic drainage or irrigation. Both methods have their supporters.

Postural drainage to the vast majority of surgeons and patients is the simpler and less harmful method. With its details (and they are important) I am sure you are familiar. As the method has more widely and intelligently been used, the number of cases of acute pulmonary abscess cured by it has steadily increased. Berry, reporting upon 126 cases of pulmonary abscess occurring in Dr. Miller's service at Bellevue Hospital, New York, stated that more than 55 per cent of the patients were cured by postural drainage alone. Many other favorable reports of the success of this method might be quoted, although not all with so high a percentage of cures.

Bronchoscopic drainage is a matter for the specialist. Its stated advantages are that it more surely establishes free drainage, for with each introduction of the bronchoscope the drainage tract may be dilated or masses of granulation tissue obstructing the communication between abscess and bronchus removed. It is not surprising that there should come from this city (Philadelphia)—the home of superlative bronchoscopy—a report of the highest percentage of cases in any individual series of which I know treated by this method. Flick, Clerf, Funk and Farrell in 172 cases of pulmonary abscess referred 127, or 70 per cent, for bronchoscopic treatment. The results were as follows: 54 per cent of the patients were cured, 13 per cent were improved, 6 per cent were unimproved, and 23 per cent were referred for surgical treatment. Under undoubtedly the best conditions, bronchoscopic treatment yielded the same results with respect to cures as have been obtained by postural drainage. It has not yet been shown, therefore, that bronchoscopic treatment as a routine measure is superior to postural drainage. Bronchoscopy, however, is a very valuable adjunct in the management of pulmonary abscess. From a diagnostic viewpoint it may serve to differentiate simple abscess and abscess in association with malignant disease; it may establish the presence of non-opaque foreign bodies; or it may demonstrate bronchial stenosis proximal to an abscess. In the treatment of abscess it may be valuable in such cases in which postural drainage does not succeed in abating the malodorous sputum from chronic abscesses and so forth. In the hands of trained bronchoscopists and within the limitations which they have established there can be no objection to its use as a routine method of treatment since it has yielded such splendid results.

Intravenous therapy, or, the use of arsphenamine and arsphenamine preparations has been advocated in cases of primary gangrene associated with organisms common to the mouth as described by Kline and Berger. They insist upon the importance of early diagnosis and early intensive treatment with large doses of arsenical preparations (0.9 gram neoarsphenamine every 72 hours in some cases). In 15 cases treated by this method 11 recovered. The treatment has been applied generally to such lung abscesses as show spirochætæ, fusiform bacilli, and vibrios in the sputum. The results thus far reported vary. Miller in a series of 126 cases of lung abscess, treated between 40 and 50, all of which had foul sputum containing spirochætæ and other organisms with arsenical preparations with

disappointing results. Others report similar experiences. Graham (11) on the other hand stated that many of the cases associated with spirochætal infections become healed in a dramatic manner merely by the use of an intensive course of treatment with neosalvarsan. Further information on the intensive treatment of early cases is desirable.

Vaccine therapy. Cole (4) has found that vaccine in large doses (2 to 3 cubic centimeters twice a day) has cleared up some pulmonary abscesses which were resistant to other forms of treatment. This subject also deserves further study.

Surgical drainage. Should the above non-surgical measures or their combinations fail and should the abscess in question be a single peripheral abscess, surgical drainage is the next procedure to be contemplated. The question when to institute surgical drainage in the treatment of pulmonary abscess is difficult to answer. It would appear justifiable in the majority of cases to try non-surgical methods at least for 6 to 8 weeks checking the progress of the patient by the usual clinical observations, by careful X-ray studies, and by sputum examinations. If improvement is positive and more or less continuous the treatment may be continued; if definite improvement does not follow or if the condition becomes less favorable, it may be advisable to terminate the use of non-surgical drainage before or at the expiration of a 6 or 8 weeks' interval. No set rules regarding this matter can be stated; for as in so many other conditions the determination of when to operate depends upon the experience and judgment of the surgeon. Too much procrastination in cases suitable for drainage is, I believe, inadvisable; for unexpected attacks of bronchopneumonia, serious hæmorrhage or extension of the process to the pleura with the development of empyema may carry off patients who might have been saved if operative treatment had been more timely.

The cases most favorable for surgical drainage as I have indicated are the single, peripheral abscesses. By single I mean single with reference to the lobes of the lung; for there may be two such abscesses in one individual. Accurate localization and the determination, if possible, of the presence or absence of adhesions between visceral and parietal pleuræ are important before operation is undertaken. The technique of the operation, whether done in one or two stages, I assume is known to all of you. The operation has been enlarged by some to include the resection of several ribs over the abscess and the excision by cautery of its presenting wall in order more quickly and surely to obliterate the abscess cavity. The postoperative care of the patient is important; and my own experience would make it appear advisable to keep the patient under observation in a hospital until the abscess is completely obliterated and healed. The results have varied greatly. In the past we often operated upon patients who now are cured by non-surgical drainage and occasionally had a remarkably satisfactory experience; on the other hand we often failed to diagnose accurately the condition with reference to the number, size, and character of the abscesses and used drainage in instances which we now know were unsatisfactory for this procedure. Since the advent of non-surgical drainage, surgery has been confined practically to the chronic cases which are obviously the more difficult to treat. By and large the results show a mortality of from 20 per cent to 40 per cent and a cure or great improvement in from 40 per cent to 80 per cent.

If the abscess under consideration is not single and peripheral but central, or multilocular, or multiple, the question of how next to proceed after non-surgical drainage has failed is at present problematical. Surgical drainage may in certain cases seem to meet best the indications but in others one of the following procedures will be employed depending upon the particular leanings of the surgeon.

Artificial pneumothorax. The purpose of the method is to collapse abscess cavities which drain freely into a bronchus. It should yield the best results, therefore, in early abscesses, before the development of a thick rigid fibrous wall. It is not applicable, of course, in peripheral abscesses in which there are adhesions between the visceral and parietal pleuræ, or in abscesses of the lower lobe with adhesions between the lung and diaphragm. The reports of the results of this

method vary greatly. In their own experience with 18 cases, Whittemore and Balboni found that only 11 per cent were cured and 33 per cent died during or as a result of the treatment. In a study of the literature these authors found on the other hand that among 129 collected cases (reported between 1903 and 1928) 52 per cent were cured, 9 per cent were not improved, and 14 per cent died. Significant perhaps of a poor selection of cases is their finding that 8.5 per cent of the patients developed empyema after the induction of pneumothorax. As a result of their careful studies Whittemore and Balboni found that the patients most likely to respond favorably to this method are those in whom the following conditions are fulfilled (1) the abscess is situated centrally; (2) it communicates with a bronchus; (3) the treatment is established within 3 or 4 months from the onset of the disease; (4) a complete or almost complete collapse of the lung can be obtained, and (5) the treatment can be continued for 3 or 4 months. They are, of course, precisely the conditions one would expect to be most favorable for the success of this method.

Phrenicotomy. This procedure would find perhaps its greatest usefulness in abscess of the lower lobe. The effect of temporary or permanent paralysis of the diaphragm is to restrict the activity of the lower lobe and favor the collapse of an abscess cavity. Yates believes that it serves a more fundamental purpose in that it brings into play those factors which combat pleuropulmonary inflammations such as the improvement of the quality of the blood in circulation, the reduction, but not the abolition, of pulmonary excursions and the decrease in the cardiac effort. Judgment regarding the value of this procedure must for the present be deferred.

Thoracoplasty. Thoracoplasty has been suggested and tried in cases of chronic multiple lung abscesses associated or not with bronchiectasis, in which artificial pneumothorax is impossible because of adhesions. The purpose of the procedure, as in artificial pneumothorax, is the collapse of the abscess cavities and theoretically the operation should, likewise, be performed early. Hedblom (13) states, however, as a result of clinical experience that collapse of rigid walled abscesses may be accomplished. It is conceivable that the procedure may, in some cases, defeat the purpose for which it was undertaken; for drainage from one or several of a group of multiple abscesses may be actually obstructed by collapse. The results of thoracoplasty in pulmonary abscess are difficult to appraise. Cases so treated are often referred to as cases of chronic non-tuberculous pulmonary suppuration and a distinction between chronic abscess and bronchiectasis (if the two conditions are possible of differentiation) is not often made. Lilienthal in 13 cases of chronic, non-tuberculous pulmonary suppuration reports four recoveries (30 per cent) and five deaths. Hedblom in 20 cases presumably largely instances of bronchiectasis found that 3 were cured and 8 so greatly improved as to be rehabilitated. Fifty-five per cent of the patients, therefore, were greatly improved. Four died (20 per cent) directly as the result of the disease and 2 died from other causes. Other statistics might be quoted but these give some idea of the results achieved.

Cautery pneumectomy. This operation as advocated particularly by Graham (12) consists in the exposure of the diseased lung by rib resection and the removal of the diseased tissue by means of the actual cautery. It is done in multiple stages. The tissue burned by the cautery sloughs away leaving a granulating cavity opening upon the surface of which are a varying number of bronchial fistulæ. The wound heals by granulation or is closed by plastics. Graham himself reserves this procedure for the most refractory chronic cases and finds that in general the results have been better in cases in which the chief features are those of chronic or multiple abscess rather than those of bronchiectasis. In 45 cases 69 per cent recovered and were free from symptoms; 66 per cent died immediately after operation; and 24 per cent were dead from all causes after a period of 3 years.

Lobectomy. Lilienthal in this country has been the most consistent advocate of this major procedure. It is to be considered only in the most refractory chronic cases. The mortality is very high. In 70 cases which I collected recently, the mortality was 52 per

cent. Lilienthal (24), however, after comparing the results of lobectomy with those of various other procedures in 105 cases of chronic non-tuberculous pulmonary suppuration, suggests that when recoveries occur they are more complete and satisfactory than after other procedures; and against the high primary mortality must be balanced not only the immediate but the eventual mortality from complications directly attributable to the pulmonary disease. In 34 cases of lobectomy reported by this author 26 per cent were cured, and about 60 per cent died. Lobectomy following a primary thoracoplasty has also been suggested and tried for certain cases. The recorded cases are still too few to permit any definite conclusions regarding its value.

This summary largely covers the various methods used in the treatment of pulmonary abscess in its various forms. Regardless which may be used, general measures such as rest, good food, fresh air, heliotherapy, and blood transfusions, when indicated, should be combined with it. It must be apparent from our discussion that there can be no set and fixed way of treating pulmonary abscess in all its manifestations and that each case constitutes an individual problem.

BIBLIOGRAPHY

1. Allen. Arch. Surg., 1928, xvi, 171.
2. Archibald and Brown. Am. Rev. Tuber., 1927, xvi, 111.
3. Berry. Discussion, Kline and Berger, loc. cit.
4. Cole. Discussion, Kline and Berger, loc. cit.
5. Corper. J. Am. M. Ass., 1922, lxxviii, 1858.
6. Crowe and Scarff. Arch. Surg., 1928, xvi, 176; Scarff, Arch. Surg., 1929, xviii, 1960.
7. Cutler and Schleuter. Ann. Surg., 1926, lxxxiv, 256.
8. Daly and Daly. Texas State J. M., 1927, xxiii, 277.
9. Fetterolf and Fox. Proc. Am. Laryngol. Ass., 1923, p. 252.
10. Flick, Clerf, Funk, and Farrell. Arch. Surg., 1929, xix, 1292.
11. Graham. Cited by Kline, loc. cit.
12. Graham. Personal communication.
13. Hedblom. Arch. Surg., 1924, viii, 395; J. Am. M. Ass., 1927, lxxxix, 1384.
14. Hedblom, Joannides, and Rosenthal. Ann. Surg., 1928, lxxxviii, 823.
15. Hermann and Cutler. J. Clin. Investigation, 1929, vii, 501.
16. Hoelscher. Arch. f. klin. Chir., 1927, lvii, 175.
17. Holman. Northwest Med., 1926, xxv, 290.
18. Iglauer. Ann. Otol., Rhinol., & Laryngol., 1928, xxxvii, 231.
19. Joannides. Surg. Gynec., & Obst., 1928, xlvii, 449.
20. Kline. J. Infect. Dis., 1923, xxxii, 481.
21. Kline and Berger. Arch. Surg., 1929, xviii, 481.
22. Lambert and Weeks. Arch. Surg., 1929, xviii, 516.
23. Lilienthal. Ann. Surg., 1914, lix, 855; 1922, lxxv, 257; Thoracic Surgery. Philadelphia: W. B. Saunders Co., 1925.
24. Idem. Arch. Surg., 1928, xvi, 206.
25. Miller. Discussion in Kline, loc. cit.
26. Mullin and Ryder. Am. Rev. Tuber., 1920, iv, 683.
27. Myerson. Laryngoscope, 1922, xxxii, 929; 1924, xxxiv, 63.
28. Ochsner and Nesbit. Arch. Otolaryngol., 1907, vi, 330.
29. Scarff. Arch. Surg., 1929, xviii, No. 2, 1960.
30. Schleuter and Weidlein. Arch. Surg., 1927, xiv, 457.
31. Singer. Arch. Surg., 1927, xiv, 167.
32. Smith, D. T. Am. Rev. Tuberc., 1927, xvi, 584; J. Infect. Dis., 1930, xlvi, 303.
33. Idem. Personal communication.
34. Idem. Am. Rev. Tuberc., 1927, xv, 352.
35. Idem. J. Infect. Dis., 1930, xlvi, 303.
36. Idem. Cited by Lambert and Weeks, loc. cit.
37. Tunnicliff. J. Infect. Dis., 1906, iii, 148; 1911, viii, 316.
38. Van Allen, Adams, and Hrdina. Arch. Surg., 1929, xix, 1262, 1279.
39. Varney. Arch. Surg., 1929, xix, 1602.
40. Whittemore and Balboni. Arch. Surg., 1928, xvi, 228.
41. Yates. Arch. Surg., 1928, xvi, 311.

PATHOGENESIS, DIAGNOSIS, AND TREATMENT OF BRONCHIECTASIS[1]

CARL A. HEDBLOM, M.D., F.A.C.S., CHICAGO

BRONCHIECTASIS is characterized pathologically by dilatation and inflammatory changes in the walls of one or more subdivisions of the bronchial tree. The dilatation may be congenital or acquired. In congenital bronchiectasis it is the dilatation only that is congenital. Only if a chronic infection develops in the congenitally dilated bronchi do the characteristic symptoms appear. Such secondary infection may supervene early or late in life, or never. Necropsy findings of bronchial dilatation are reported in adults who never had any symptoms of bronchiectasis. When symptoms and signs do appear they are indistinguishable clinically from those of the acquired type. Therefore, the relative incidence of the congenital and the acquired type is indeterminate.

PATHOGENESIS

The nature of the processes that bring about congenital dilatation of the bronchi is for the most part obscure. In some cases there appears to be an arrested development, "agenesis of the alveoli" (Kaufmann), in others collections of fluid are described in the fetal bronchioles (Grawitz). In some the histology is that of a congenital fetal adenoma (Stoerch). Sauerbruch thinks that the mechanical crowding of the left main bronchus during early development is the important etiological factor. Some observers believe that intrauterine syphilis plays an etiological rôle (Balzer and Grandhomme). Whatever the cause may be we cannot prevent congenital dilatation.

Two fundamental processes enter into the development of acquired bronchiectasis, namely, infection that weakens the bronchial walls and mechanical force that produces the dilatation. It is this mechanical stress which I would emphasize and to which I would direct particular attention because of its importance to both prevention and cure.

The mechanical force that produces bronchial dilatation may be applied as pressure from within the bronchus or as a pulling force from without. Atmospheric pressure is the most important if not the only mechanical factor causing dilatation in those cases in which there is no marked pathological change in the lung parenchyma or pleura. During the height of deep inspiration the intrabronchial pressure, i.e., that inside the bronchus, is from 10 to 20 centimeters of water more than the intrapleural pressure, which means that atmospheric air exerts that much intrabronchial pressure. The normal bronchus has sufficient strength and elasticity to withstand this stress, but the one which has lost its elasticity and muscular support due to a destructive inflammatory process, dilates. The deep inspiration just preceding coughing produces a maximal difference between intrapleural and intrabronchial pressure, and so the greatest degree of dilating stress.

Most writers on the subject consider the violent expiratory phase of coughing as an important, if not the direct, cause of bronchial dilatation. They have erroneously assumed that during the instant the glottis is closed, just before the expiratory blast of air, there results a greatly increased dilating intrabronchial pressure. It is true that the intrabronchial pressure is raised but the force which brings it about is applied to the outside of the lungs and bronchi by the chest wall and abdominal muscles forcing the diaphragm upward. The pressure inside and outside the bronchial wall is therefore the same, and there is no dilating effect. Partial obstruction of the bronchus, impeding the exit of air, may exert some dilating effect by the same mechanism as produces emphysema.

Pulmonary atelectasis is an important cause of bronchial dilatation. The mechanism is that of lessening the support to the outside of the bronchus. Manometric readings of the intrapleural tension in pulmonary atelectasis show as much as 45 centimeters less than atmospheric pressure. This, then, presents the dilating atmospheric stress. Other mechanical

[1] Presented before the Clinical Congress of the American College of Surgeons, Philadelphia, October 13–17, 1930.

effects of this unopposed stress are the shifting of the heart and mediastinal structure toward the affected side, the elevation of the diaphragm, and retraction of the chest wall. The most marked grade of ampullar and saccular bronchial dilatations are observed in cases of persistent atelectasis in which the heart has remained greatly displaced.

Persistent fetal atelectasis is favored by the relationship between the lung and pleural cavity at birth. At that stage of life the volume of the pleural cavity is only slightly greater than that of the contained lung. The elastic tension of the lung is therefore slight and the negative intrapleural tension is correspondingly low. Beginning respiration results in relatively feeble inspiratory inflation of the fetal alveoli, and some of them may remain in the fetal atelectatic state, or, as a result of intercurrent disease, may become atelectatic during infancy and early childhood and remain so. Later the pleural cavity grows relatively more voluminous than the lung. There results, therefore, increasing dilating stress in the bronchi.

Bronchial obstruction is probably the chief cause of atelectasis. Lichtheim showed that the complete closure of the bronchial lumen leads within 24 hours to atelectasis of the corresponding parenchyma with purulent secretion within the obstructed bronchi. After a few weeks the bronchi near the site of the obstruction dilate. The mechanism is that of atelectasis.

Complete or incomplete foreign body obstruction, cicatricial stenosis, or extramural pressure are well recognized causes of bronchiectasis. Reynaud, one of the earliest writers on the subject, observed that dilatation occurs both distal and proximal to the obstruction and in the neighboring unobstructed branches. This may be explained in part on the basis of increased difference between the atmospheric and intrapleural pressure.

Scar tissue retraction in the lung parenchyma is the source of the extrabronchial traction that results in dilatation. The etiological relationship between fibrosis of the lung and bronchiectasis was first emphasized by Corrigan. Sauerbruch observes that after ligating the pulmonary artery, a high grade shrinkage develops in the part of the lung involved, and even after a few months the bronchi dilate. In case of extreme pulmonary fibrosis and shrinkage of the lung, displacement of the heart and mediastinal structures, elevation of the diaphragm and retraction of the chest wall is similar to that from atelectasis, plus extrabronchial traction. In some right sided cases a complete dextrocardia results. However, the dilating effect of inspiration on the shrunken lung is reduced by the retraction and partial immobility of the chest wall on the affected side. This immobilization probably accounts for the absence of bronchial dilatation in some cases of extensive fibrosis. In other cases there may be no bronchial damage.

The bronchial dilatation frequently seen in chronic fibroid phthisis may be similarly accounted for chiefly on the basis of scar tissue retraction of the bronchial walls.

In cases of chronic pulmonary abscess, large, and at times enormous, dilatations of the smaller bronchi are found. In these cases there is probably a combination of atelectatic dilatation and scar tissue pull.

In some types of atelectasis and in some cases of chronic fibroid disease of the lung the dilatation of the bronchi possibly may precede infection, as in the congenital type, but in the vast majority of cases the infection precedes or is concurrent with the mechanical factors.

The infection or diseased condition that gives rise to the inflammatory process that weakens the bronchus may be considered the antecedent or exciting cause. In many cases observed soon after the onset of symptoms, a definite relationship of the bronchiectasis to a preceding illness can be established beyond reasonable doubt, but in many there is no ascertainable exciting cause. In a large proportion of cases of long standing, particularly those beginning in childhood or infancy, the statements made by the patient or family are unreliable. These cases must be considered as of indeterminate origin.

In a series of 552 cases, bronchitis or recurrent colds was the probable antecedent cause in 16 per cent; some type of "pneumonia" in 16 per cent; the infectious diseases of childhood

in 13.6 per cent; foreign body in a bronchus in 5.2 per cent; postoperative pulmonary infection in 4.7 per cent. Generally speaking, the bronchial tract was involved in a little more than one-quarter of the cases, the lung in one-third of the cases, and about one-third of the cases were of indeterminate origin.

DIAGNOSIS

The diagnosis of bronchiectasis up to recent years was beset with uncertainty and was usually made after it had masqueraded for years as chronic bronchitis, pulmonary tuberculosis, asthma, abscess, and other disease conditions. A history of a chronic cough with purulent or mucopurulent sputum, expectorated during paroxysmal attacks of cough, especially incident to stooping or sudden changes in position, is the characteristic syndrome. The amount of sputum varies from a few cubic centimeters to a liter. Hæmoptysis of some grade occurs in upwards of one-half of the cases. If the onset dates from an acute illness involving the respiratory tract those symptoms are all the more suggestive of bronchiectasis, but it must be remembered that there is no ascertainable etiology in more than one-quarter of the cases. Children may have a slight elevation of temperature, but adults usually do not have fever except with acute exacerbations of the inflammatory process. Most patients remain for years in very fair general condition. Dyspnœa and pain are usually late symptoms.

Relatively normal physical findings are more characteristic of the disease than outstanding signs of abnormality. Râles heard periodically at the base of the lung is the most common finding; bilateral râles may mean bronchiectasis on one side and bronchitis on the other. Only when there is associated involvement of the lung parenchyma or pleura will there be changes in auscultation and percussion. Clubbing of fingers and toes is a common but not constant sign.

The sputum is more often odorless than foul smelling. It was foul smelling in only one-third of my cases. The three layer sedimentation test seems to me of no particular diagnostic significance. Microscopic examination is of importance in differentiating pulmonary tuberculosis and actinomycosis and in determining the presence or absence of spirochætæ and fusiform bacilli. If these organisms are present arsphenamin treatment is indicated.

The ordinary roentgenogram in bronchiectasis may show normal findings. So frequently has this been the case in my experience that I have been led to regard such findings in the presence of typical symptoms as characteristic of bronchiectasis. Abnormalities when present are due to changes in the bronchial wall, to the varying content of the bronchial lumen, and the associated pathology in the lung parenchyma or the pleura. The changes from the normal in the roentgen plate are in the form of intensified linear markings and areas of increased densities, which may be circumscribed or diffuse, uniformly or irregularly translucent, or mottled. Associated atelectasis, fibrosis, or pneumonic consolidation produces superimposed shadows.

Hartung made a comparative study of the ordinary and contrast media roentgenogram in 72 cases of bronchiectasis. He concluded that the correct diagnosis, both as to the presence and the site of the lesion, could be made in only 20. In 39 it was impossible to make a diagnosis either as to the presence or location of the lesion, because there were no abnormal findings or because the lesion was obscured by the heart or diaphragm shadow or by fibrosis.

The introduction of the principle of contrast media roentgenography in the study of the bronchial tract represents the greatest advance in the differential diagnosis of bronchiectasis since the advent of the roentgen ray method. Not only is it possible to establish the diagnosis beyond peradventure, but to make it early, even in its incipience when most amenable to treatment. Hitherto the presence of bronchiectasis in a typical case would be established by the clinical findings with the roentgenogram to exclude other conditions, but the all important question with regard to treatment as to unilateral or bilateral involvement often remained in serious doubt. Even if this was fairly definitely demonstrated, the extent, character, and particular

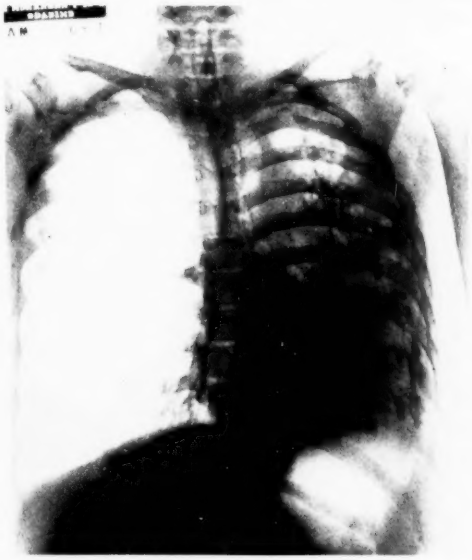


Fig. 1. C. G., male, aged 11 years. Lipiodol roentgenogram before artificial pneumothorax collapse. Note mediastinal displacement toward the affected side. Manometric reading before first instillation of air showed between 20 and 30 centimeters of water, less than atmospheric pressure. Marked clinical improvement in 3 weeks following partial pneumothorax collapse of the lung.

Fig. 2. S. P., male, aged 65 years. Lipiodol roentgenogram showing postpneumonic ampullar bronchiectasis. Note displacement of trachea and heart toward diseased lung indicative of increased tension in left pleural cavity.

subdivision of the bronchial tree involved remained indeterminate. Contrast media bronchography has passed through the experimental stage and has acquired an importance as a diagnostic method in the study of bronchiectasis comparable to contrast media roentgenographic studies of the gastro-intestinal and urinary tract and gall-bladder disease.

The methods of introduction are fully described in the literature. Because of its general applicability and certainty of result I have preferred the transtracheal method or the oral method described by Pritchard.

The differential diagnosis involves chiefly the exclusion of chronic bronchitis, pulmonary tuberculosis, unresolved pneumonia, pulmonary abscess, and empyema with bronchial fistula. Contrast media bronchography constitutes the crucial test in the differentiation of bronchiectasis from all these conditions. Tuberculosis is established by the finding of tuberculosis bacilli in the sputum, but bronchiectasis may be secondary to chronic fibroid phthisis. Early diagnosis and prompt relief of mechanical tension by collapse therapy will arrest the progress before the bronchi have become extensively involved or widely dilated, and before the lung parenchyma has become secondarily affected. Such therapy will also collapse the dilated secondary bronchial subdivisions, and the fibrosis that results exerts a collapsing and healing effect on the larger subdivisions.

The dilating mechanism can be removed or neutralized by surgical means. Bronchoscopic removal of an obstructing foreign body, secretion, growth, granulations, or stenosis, while the alveoli are still intact, will result in their re-inflation and this will relieve the abnormal dilating tension. In cases in which the atelectatic condition has become permanent, or in which scar tissue shrinkage has caused an abnormally low intrapleural tension, this tension as well as the dilating pull of the scar tissue will be neutralized by partial or complete collapse of the lung. If the scar tissue is

Fig. 3. A. B., female, aged 24 years. Lipiodol oblique roentgenogram showing cylindrical type of bronchiectasis on right.

Fig. 4. Same case as in Figure 3 taken 1 year later, showing progressive bronchial dilatations to ampullar type on right and cylindrical bronchiectasis on left.

that of a fibroid phthisis, resting of the lung and obliteration of cavities constitute additional indications for pulmonary collapse. In case of bronchiectasis secondary to chronic pulmonary abscess, a partial pulmonary collapse is often necessary for the obliteration of the abscess cavity.

Even in cases in which the contrast media roentgenogram shows well marked dilatations of long duration, there is a tendency to more extensive involvement and at least in some cases to a transition from the less wide tubular to the much more spacious saccular dilatations. It seems reasonable to assume that this is due to the continued action of the dilating mechanism which may be counteracted or neutralized by surgical means.

There exists considerable difference of opinion as to the healing effect of collapse or compression therapy in case of advanced bronchiectasis. The older literature contains many statements to the effect that the bronchiectatic lung parenchyma cannot be collapsed on account of the extensive sclerosis. But the great majority of cases of bronchiectasis as demonstrated by contrast media roentgenography are not associated with any marked sclerosis and may be collapsed to a marked degree. It has been asserted that the dilated bronchi are incompressible. This holds true of the larger subdivisions of the bronchial tree with strong cartilaginous support, but not of the smaller subdivisions most frequently involved. In three necropsy specimens of lung collapsed for several years by thoracoplasty, which I have had the opportunity to examine, most of the bronchi had completely disappeared. There was an extreme grade of fibrosis replacing the normal architecture of the lung. This fibrosis with shrinkage made possible by the collapsed condition of the lung, probably accounts for the obliteration of the bronchi.

Congenital bronchiectasis, as stated, cannot be differentiated with any certainty clinically from the well advanced chronic acquired type. The treatment of both types must, therefore, necessarily be much the same. The methods of pulmonary collapse so

far employed have been phrenic neurectomy, artificial pneumothorax, extrapleural thoracoplasty, and pneumolysis. The results so far reported largely antedate the introduction of contrast media bronchography, and include, therefore, for the most part relatively unfavorable advanced cases of long standing. A review of the reports in the literature shows encouraging results in spite of such late treatment.

PHRENIC NEURECTOMY

Evulsion of the phrenic nerve brings about a paralytic relaxation of the diaghragm and a consequent diminution of the pleural cavity, estimated at from 15 to 30 per cent of its original volume. The relaxed condition of the diaphragm results in a greater degree of compression of the lung during the expiratory phase of coughing, and so facilitates the more thorough evacuation of the purulent secretion. Many patients volunteer the statement that they raise the sputum with less effort.

The degree of improvement as measured by the decrease in sputum and cough depends on the site and extent of involvement and on the height to which the dome of the diaphragm rises, and consequently on the collapse of the basal portion of the lung. Peripheral dilatation of recent origin is the most favorable type. Dilatations of the larger bronchial subdivisions and those situated medially are less affected.

In a series of 38 cases in my experience, 9 have remained symptom-free for from 3 months to 3 years. In 20, the sputum decreased from 50 to 80 per cent. In 7, there was some improvement. In 2, there was no improvement. Chauffard, Bogendoerfer, Rist, and others report symptomatic cures. Davies writes that of 5 cases in which the operation was done in the hope that it might be self-sufficient, 4 gained no benefit, but the fifth was relieved of all symptoms during a period of 2 years. In 2 other cases in which the operation was done as a preliminary to thoracoplasty, the improvement was so marked that thoracoplasty was indefinitely postponed.

Phrenic nerve evulsion is so simple and safe, and the probability of improvement is so considerable, that it should be done in all early unilateral cases. Even though it may not materially improve cases with centrally situated lesions, it will lessen mechanical tension and so retard the further progress of the disease.

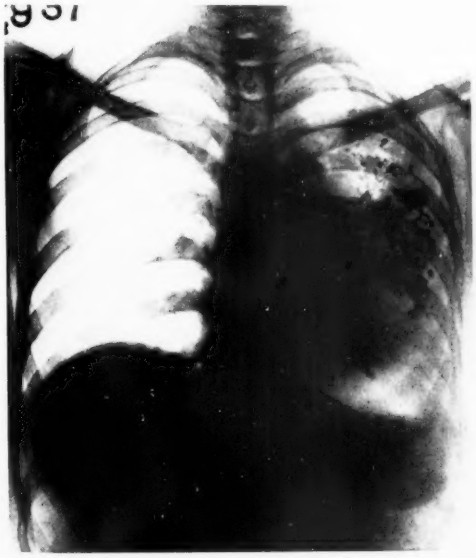


Fig. 5. L. McC., female, aged 26 years. Lipiodol roentgenogram showing bronchial dilatations following chronic pulmonary abscess healed by thoracotomy drainage.

ARTIFICIAL PNEUMOTHORAX COLLAPSE

If the principle of pulmonary collapse is accepted, therapeutic pneumothorax is a rational method of arresting the process in early cases and for securing fibrotic obliteration of dilatations involving the peripheral bronchial subdivisions. The method is naturally limited to those cases in which the pleuræ are not adherent and the lung parenchyma not involved in the inflammatory process. It possesses the inherent disadvantage that refills are necessary for a long period of time.

Many cases of improvement approximating a cure are reported. Among 65 cases collected by Tillman, 11 were slightly improved, 17 markedly improved, and 16 (36.3 per cent) remained completely free of symptoms during a period of observation of from 6 months to more than 1 year. Whittemore and Balboni

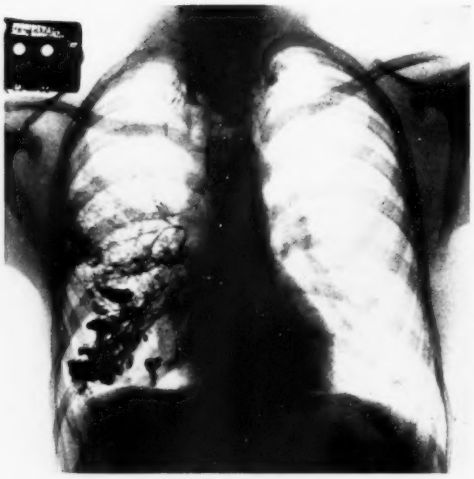


Fig. 6. J. B., male, aged 12 years. Lipiodol roentgenogram before phrenic nerve resection showing ampullar type of bronchiectasis. Posttonsillectomy pulmonary "abscess" and empyema at age of 7 years. Drainage of empyema with healing after 3 months. Persistent cough with purulent sputum since.

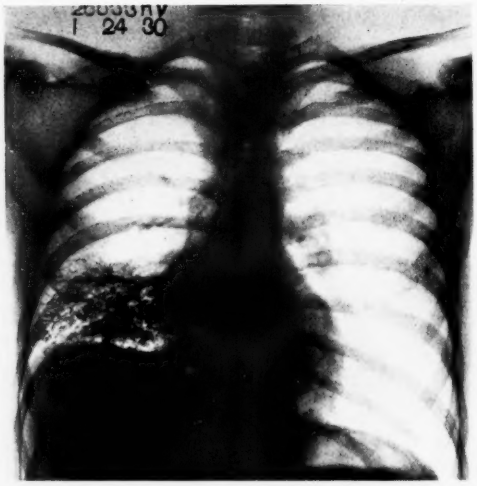


Fig. 7. Same case as in Figure 6. Lipiodol roentgenogram after phrenic neurectomy. Note complete disappearance of ampullar dilatation. Almost complete symptomatic cure during a period of observation of 3 years.

report 1 patient cured after 80 weeks and 1 improved but still under treatment after 28 weeks. Of 93 cases collected from the literature they found 14 (15 per cent) reported cured; 44 were reported more or less improved, some greatly so. Seven were reported as having died, but 2 of these deaths followed thoracoplasty. In 12 cases pneumothorax could not be induced.

Pneumothorax collapse will probably find a definite field of usefulness in early unilateral cases, particularly in children, in case of whom phrenic neurectomy is insufficient to control the symptoms.

EXTRAPLEURAL THORACOPLASTY

Extrapleural thoracoplasty involves the collapse of the lung by extensive rib resection. It is not an ideal operation as it does not remove the diseased tissue nor restore it to normal, but it relieves the bronchi of the progressively dilating tension, and in properly selected cases it produces improvement approximating a cure. Of all methods of compression, it is the most generally applicable. It produces a degree of collapse which can be made to approximate that following artificial pneumothorax and which is not limited by adhesions. Operative shock can be avoided and the danger incident to retention of secretion can be minimized by dividing the operation into several stages. If the collapse does not sufficiently relieve the symptoms, it prepares the way for later lobectomy or cautery extirpation.

The most favorable type is the early peripheral unilateral cylindrical lesion in cases in which phrenic evulsion has not produced sufficient improvement. Large saccular dilatations lying posteriorly and close to the mediastinum are least influenced by the chest wall collapse, and most prone to develop retention of secretion. Early thoracoplasty, however, will relieve the excessive grade of negative intrapleural tension incident to an etiological atelectasis, and so prevent the formation of such sacculations. Cylindrical dilatations of the larger bronchial subdivisions are least suitable from the standpoint of existing symptoms, but the operation may be expected to check the peripheral extension of the lesion. The nodular type associated with a tuberculous fibrosis presents a double indication in that thoracoplasty is indicated for

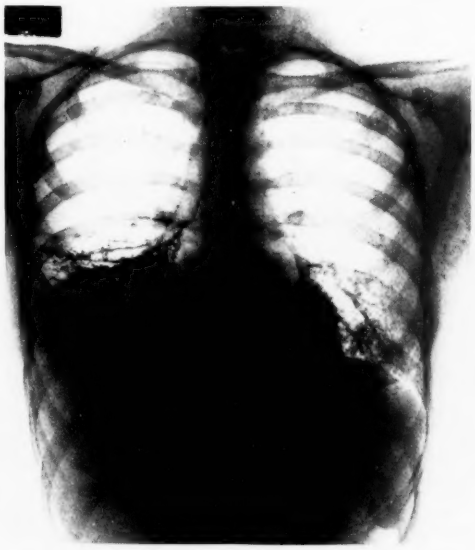


Fig. 8. E. S., female, aged 29 years. Lipiodol roentgenogram showing cylindrical bronchiectasis following laparotomy one year before. Sputum averaging about 180 cubic centimeters in 24 hours. Patient lost her clerical position on account of persistent cough and foul odor to breath and sputum.

Fig. 9. Same case as in Figure 8. Lipiodol roentgenogram following phrenic neurectomy. Patient has been symptom free and working for her former employers for 3 years following operation.

the fibrous type of tuberculosis. Mediastinal displacement and marked retraction of the chest wall due to fibrous tissue retraction in the cirrhotic type of bronchiectasis, constitute an additional mechanical indication for mobilizing the chest wall.

Some cases of long standing have developed so much sclerosis secondary to the retraction that the degree of pulmonary collapse attainable will not materially influence the symptoms. Combined bronchiectasis and multiple abscess evidenced by a septic temperature, high leucocytosis, an excessive amount of sputum, and other constitutional findings of marked toxic absorption in my opinion does not offer sufficient prospect of material benefit from thoracoplasty to warrant the operative risk.

The thoracoplasty may be performed by a typical posterior paravertebral resection of the upper eleven ribs, after the method of Sauerbruch, or by a resection of the whole length of the lower ribs. The posterior resection is the simplest, but is open to the objection that the whole lung is collapsed for a disease involving typically the base of the lower lobe only. Resection of the posterior segments of the lower ribs only does not produce sufficient collapse of the lower lobe. It is the drop of the whole chest wall made possible by sectioning all the upper ribs, including the first, that gives the marked grade of collapse obtained by this operation.

The upper part of the lung may be maintained expanded with extensive collapse of the base, by resecting the whole length of the third or fourth, to and including the eleventh. The intact upper ribs maintain the apex uncollapsed and the middle portion of the lung in partial expansion. Phrenic nerve evulsion by raising the diaphragm against the diseased base aids materially in compressing the lower lobe.

The imperfect results reported have probably been due in considerable measure to failure to perform an operation sufficiently

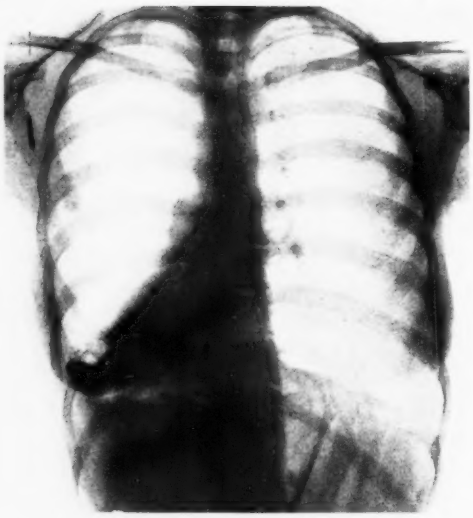


Fig. 10. K., female, aged 21 years. Lipiodol roentgenogram before thoracoplasty showing extensive ampullar bronchiectasis behind heart shadow. Ordinary roentgenogram showed normal findings. History of cough at age of 3 years with exacerbations following whooping cough at age of 9 years, influenza at age of 13, and pneumonia at age of 19. Sputum varied from 120 to 150 cubic centimeters in 24 hours. Note cardiac displacement to the left.

extensive to secure complete collapse of the diseased portion of the lung, and the postoperative mortality has probably been due in large measure to doing too much at one stage.

In 1926, I reported 14 cases in which I had done a thoracoplasty in five stages, without operative mortality. Three of the patients were entirely relieved of all their symptoms and have remained symptom free since. Seven of the patients have continued to raise sputum amounting to 10 to 20 per cent of what they raised before the operation. Six of the 7 have been working regularly. Four, whose symptoms were greatly relieved, died from 10 months to 2 years after operation, 1 from actinomycosis infection, 1 from drug poisoning, 1 from pulmonary hæmorrhage, and 1 following secondary operation.

Eighteen additional patients have been operated upon since, several by a three stage operation. Four of these patients died, 1 on the ninth day following a first stage resection of four ribs, from a brain abscess; 1 on the seventh day after a similar first stage operation, from retention pneumonia; a third on the eighth day after a second stage operation, from pulmonary gangrene; and the fourth after completion of a posterior resection of the upper eleven ribs, with symptoms suggesting pneumonia. Necropsy showed a clinically unrecognized fairly extensive bronchiectasis in the other lung. The 14 remaining were all improved in greater or lesser measure, the sputum being reduced from 60 to 90 per cent. Two of these patients died later after secondary lobectomy and one from pulmonary hæmorrhage.

Contrast media bronchography will probably be of much value in differentiating cases of bronchiectasis with secondary fibrosis only from those with secondary abscess, in which thoracoplasty, in my opinion, is contraindicated.

EXTIRPATION OF THE DISEASED LUNG

From the standpoint of pathological anatomy, primary lobectomy would seem to be the operation of choice in bronchiectasis, but the mortality is high and not all who survive the operation are entirely cured. Lilienthal reports 34 cases; 9 (26.4 per cent) were cured; 4 (11.8 per cent) improved; and 21 (61.8 per cent) died. Sauerbruch performed a single stage lobectomy in 3 patients, all of whom died of tension pneumothorax from leakage at the bronchial stump. In a combined total of 70 cases, including the above and cases reported by Meyer, Robinson, Hitzrot, Guibal and Graham, 37, or 50.7 per cent, died. Graham found only 17 complete cures in 40 cases reviewed by him. From these figures it would seem that until the technique of primary lobectomy can be so perfected as to reduce this high operative mortality and bring about healing of the bronchial fistula in the majority of cases it will be largely abandoned for safer, even though from the standpoint of the pathology, less rational procedures.

LOBECTOMY AFTER EXTRAPLEURAL THORACOPLASTY

It has been demonstrated that extrapleural thoracoplasty is a relatively safe operation resulting in improvement approximating a symptomatic cure in a large proportion of

the cases. If the symptoms are not relieved, it serves as a preparatory operation to secondary lobectomy. The pleural cavity is obliterated by adhesions, lessening the tendency to empyema. The disturbance to respiration and circulation incident to a primary lobectomy is obviated. Ample exposure can easily be secured by wide incision without any marked symptoms of pneumothorax. Sauerbruch writes that the marked shrinkage of the lung and hilum is very favorable for lobectomy, and he did not observe any tendency for the stump to retract into the hilum. He has performed such a secondary operation in 7 cases, with 1 death and with favorable results in the others. Heidenhain, Archibald, and de Quervain report successful cases. In 1 case in which I did a secondary lobectomy, the patient had been greatly improved by thoracoplasty performed 4 years before, the sputum having been reduced from more than 500 cubic centimeters in 24 hours to less than 100 cubic centimeters, and he was able to work at hard manual labor. During the last year, however, there had been a slight increase of cough and sputum with occasional attacks of chills and fever and he had one severe hæmoptysis. The lobectomy was performed in two stages. He has been free from symptoms since. A second patient died 1 week following secondary lobectomy from a streptococcus pericarditis and a third with symptoms of air embolism during the process of mobilization of the lung preliminary to the clamping off of the pedicle.

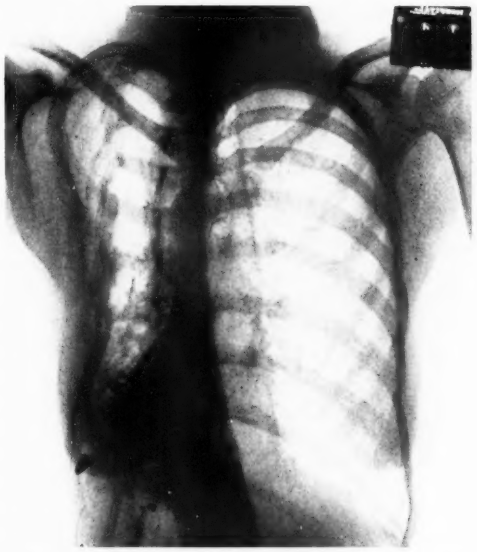


Fig. 11. Same case as in Figure 10. Lipiodol roentgenogram following phrenic neurectomy and three stage thoracoplasty. Patient was practically symptom free for 2 months, then cough and sputum recurred. Died of acute streptococcus pericarditis 1 week following mobilization of lung preliminary to lobectomy.

CAUTERY EXTIRPATION OF THE DISEASED LOBE

Rib resection for exposure and cautery destruction of the diseased portions of the lung have been carried out by Sauerbruch, Graham, and others. There is, however, some risk of hæmorrhage and embolus. Sauerbruch reports 9 cases with cure in 1 and marked improvement in 5; 3 patients died. Lorey obtained one cure. Graham reports 20 cases of "chronic pulmonary suppuration" treated by cautery lobectomy; 30 per cent of the patients were healed; 20 per cent were free from symptoms but had bronchial fistula; 15 per cent were markedly improved; in 15 per cent the records were incomplete, and 20 per cent died.

Displacing the diseased lobe through the chest wall and suturing it, allowing the projecting portion to slough away spontaneously, has been accomplished by Whittemore. Of 5 patients so operated on, he reported 2 as well; 1 improved but still having a fistula; 1 died the tenth day of pneumonia of the opposite side.

Sauerbruch reports 23 cases in which he placed a rubber band around the mobilized diseased lobe, removing the gangrenous mass in 2 or 3 weeks. After the discharge has become mucoid the bronchial epithelium is excised and the bronchus sutured. Three of the patients died, the others were completely healed.

SUMMARY

1. Bronchiectasis may be unilateral or bilateral, congenital or acquired. Most of the cases of bilateral involvement were probably originally unilateral.

2. In the congenital type the dilatations result from intra-uterine anomalies or disease.

Symptoms develop only following secondary infection. Acquired bronchiectasis is due to mechanical dilatation of bronchi weakened by infection.

3. The dilating force may be the atmospheric pressure in the presence of an intrapleural pressure reduced below the normal by atelectasis or by other cause, or it may be the extrabronchial traction of fibrous tissue or a combination of these factors.

4. The expiratory phase of coughing, during which the glottis is closed, does not produce any dilating effect, since the increased intrabronchial pressure is produced by the chest walls, and the abdominal muscles through the relaxed diaphragm, applied therefore from *without* the bronchial walls.

5. The characteristic syndrome of bronchiectasis is a chronic cough with purulent sputum, a few râles over one or both bases, and a roentgenogram showing normal findings or only slight abnormalities in a patient in fair to good general condition.

6. A positive contrast media bronchogram furnishes conclusive clinical proof, not only of the presence of bronchiectasis, but also of its site, extent, and type. It is the only means of a positive diagnosis in the incipient stage of the disease.

7. The dilating force exerted by atmospheric pressure represented by the difference between it and intrapleural pressure and the extrabronchial scar tissue dilating traction can be completely neutralized by pulmonary collapse. Early diagnosis and prompt collapse will arrest the process before the dilatation has become extensive and widespread.

8. Pulmonary collapse not only arrests the dilating process but also brings about a partial collapse of the dilated bronchi.

9. Cicatricial contraction of fibrous tissue already present and secondary fibrosis that results from long continued collapse promotes complete obliteration of the diseased bronchi.

10. The methods of partial pulmonary collapse are phrenic neurectomy, partial pneumothorax, and circumscribed thoracoplasty. Those of relatively complete collapse are pneumothorax or thoracoplasty.

11. Phrenic neurectomy is the method of choice in early cases. If it does not bring about sufficient relief of symptoms, a secondary partial pneumothorax or thoracoplasty is indicated. In cases with extensive or advanced unilateral involvement, a phrenic neurectomy followed by a graded thoracoplasty is the treatment of choice. Bilateral involvement of marked grade is beyond the hope of relief.

12. Lobectomy secondary to thoracoplasty is a safer procedure than primary lobectomy, and is indicated in those cases in which the patient is not sufficiently relieved by thoracoplasty.

13. Cautery extirpation or eradication brought about by mobilizing and prolonged contraction of the diseased lobe, are alternate methods for cases with advanced extensive lesions.

14. The best results may be expected from compression treatment in incipient cases, the early diagnosis of which is made possible by contrast media bronchography.

BIBLIOGRAPHY

1. Archibald, E. The surgical treatment of bronchiectasis. Canadian M. Ass. J., 1924, xiv, 197–203.
2. Balzer, F., and Grandhommé, A. Contribution à l'etude de la bronchopneumonie syphilitique du foetus et du nouveau-né. Rev. mens. d. mal. de l'enf., Par., 1886, iv, 485–506.
3. Bogendoerfer, L. Zur Phrenikotomie bei Bronchiektasie. Therap. d. Gegenw., Berl. u. Wien, 1922, lxiii, 203.
4. Chauffard. La phrenicotomie dans la dilatation des bronches. Clinique, Par., 1925, xx, 107–108.
5. Corrigan, D. J. On cirrhosis of the lung. Dublin J. M. Sc., 1838, xiii, 266–286.
6. Davies, H. M. Endeavor to assess value of hemidiaphragmatic paralysis by avulsion of phrenic nerve in treatment of pulmonary tuberculosis and bronchiectasis; review of 105 cases. Tubercle, Lond., 1928, ix, 205–216.
7. de Quervain. Zur chirurgischen Behandlung d Bronchiektasien. Cor.-Bl. f. schweiz. Aerzte, 191 xlii, 356.
8. Graham, E. A. Cautery pneumectomy for chron suppuration of lung. Arch. Surg., 1925, x, 392–4
9. Grawitz, P. Ueber angeborene Bronchiectasie. Ar f. path. Anat., 1880, lxxxii, 217–237.
10. Guibal, L. Sur le traitement chirurgical de la di tation bronchique chronique; quatre observati personnelles. Bull. et mém. Soc. nat. de chir., 19 i, 312–323.
11. Hartung, A. Bronchiectasis; what the use of iod oil has demonstrated relative to diagnosis by o nary roentgen examination. Am. J. Roentge 1929, xxii, 120–127.
12. Hedblom, C. A. Uncomplicated unilateral bronc tasis; late results of extrapleural thoracopla Arch. Surg., 1927, xiv, 389–405.

13. HEIDENHAIN, L. Ausgedehnte Lungenresection wegen zahlreicher eiternder Bronchiectasien in einem Unterlappen. Verhandl. d. deutsch. Gesellsch. f. Chir., 1901, xxx, 636–643.
14. HITZROT, J. M. Lobectomy for bronchiectasis. Ann. Surg., 1920, lxxi, 785–787.
15. KAUFMANN, E. Pathology. Vol. i. Philadelphia: P. Blakiston and Son Co., 1929.
16. LICHTHEIM, L. Versueche ueber Lungen Atelektase. Arch. f. exper. Path. u. Pharmakol., 1878–79, x, 54–100.
17. LILIENTHAL, H. Thoracic Surgery. Vol. ii. Philadelphia and London: W. B. Saunders Co., 1925.
18. LOREY. Ueber den Wert der Kontrastfuellung der Bronchien zur Darstellung der Bronchiektasen. Fortschr. a. d. Geb. d. Roentgenstrahlen, Hamb., 1925, xxxiii, 58–61.
19. MEYER, W. Resection of the lung for bronchiectasis. Ann. Surg., 1915, lxi, 114–116.
20. PRITCHARD, S., WHYTE, B., and GORDON, J. K. M. Use of iodized oil in diagnosis and treatment of bronchial affections. J. Am. M. Ass., 1926, lxxxvi, 1119–1123.
21. REYNAUD. Mémoire sur l'oblitération des bronches. Mém. Acad. de méd., Par., 1835, iv, 117–167.
22. RIST, E. Un cas de bronchiectase juxtadiaphragmatique guérie par la phrénicotomie. Bull. et mém. Soc. méd. d. hôp. de Par., 1924, xlviii, 1672–1675.
23. ROBINSON, S. The surgery of bronchiectasis; including a report of five complete resections of the lower lobe of the lung, with one death. Surg., Gynec. & Obst., 1917, xxiv, 194–215.
24. SAUERBRUCH. Chirurgie der Brustorgane. 3d ed. Berlin, 1920.
25. Idem. Surgical treatment of bronchiectasis. Wien. klin. Wchnschr., 1927, xl, 543.
26. STOERK, O. Ueber angeborene Blasige Missbildung der Lunge. Wien. klin. Wchnschr., 1897, x, 25–31.
27. TILMAN, J. Ueber die Pneumothoraxbehandlung der "Chronischen Bronchiektasien." Acta med. Scand., Stockholm, 1923, lix, 515–549.
28. WHITTEMORE, W. Therapy of such cases of chronic suppurative bronchiectasis as are limited to one lobe of lung. Ann. Surg., 1927, lxxxvi, 219–226.
29. WHITTEMORE, W., and BALBONI, G. M. Nontuberculous bronchopulmonary suppurative lesions. Results of treatment by artificial pneumothorax. Arch. Surg., 1928, xvi, 228–278.

SURGICAL TREATMENT OF TUMORS OF THE LUNG AND MEDIASTINUM[1]

STUART W. HARRINGTON, M.D., F.A.C.S., ROCHESTER, MINNESOTA
Division of Surgery, The Mayo Clinic

THE most important considerations in surgical treatment of intrathoracic new-growths are: early diagnosis of the lesion; careful selection of cases; pre-operative preparation of the patient; selection of the most accessible method of approach; application of adequate mechanical means for maintaining intrapleural and intrapulmonary pressure; and most rigid supervision of the postoperative care of the patient.

The significance of early recognition of these tumors cannot be overestimated. If surgical intervention is delayed, removal of the tumor may be impossible or may be attained at a greatly added risk because of the extensive involvement of, or the encroachment on, and attachment to important structures within the thorax. Large tumors may cause marked disturbance in the normal pressure in the pleural cavity and may seriously interfere with the function of the thoracic viscera, thereby increasing the operative risk.

In malignant disease the importance of early diagnosis is obvious but with all of the modern improvements in thoracic diagnostic methods, it is often impossible to distinguish between malignant and benign growths before operation. I believe that most of these tumors are potentially malignant and that they should be removed early before malignant degeneration has occurred.

The most outstanding advance in the early diagnosis of these tumors has occurred since the use of roentgen rays. The most accurate knowledge as to the type of lesion, its situation, and extent, is obtained by a series of roentgenograms taken in different positions, particularly by anteroposterior stereoscopic films, and by films made to show lateral and oblique views. In addition fluoroscopic examination is valuable. A similar series of roentgenograms should be taken in practically all cases, after induction of pneumothorax, and in cases in which pleural effusion is present after

[1] Presented before the Clinical Congress of the American College of Surgeons, Philadelphia, October 13–17, 1930.

Fig. 1. On patient's admission. Lateral view showing the tumor in the posterior mediastinum.

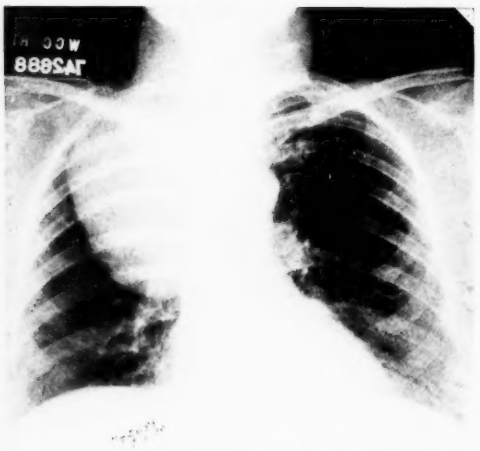


Fig. 2. Large circumscribed tumor involving entire right upper portion of thorax, extending from apex to ninth rib, probably benign tumor.

aspiration of the fluid and its replacement with gas. In some cases the roentgenograms taken after the injection of lipiodol into the bronchial tree are of additional aid in establishing a definite diagnosis. Bronchoscopic examination often is of diagnostic aid in determining the presence of an intrabronchial lesion. Thoracoscopic examination is useful in selected cases for determining the presence of lesions of the pleura or of lesions projecting into the pleural cavity. Occasionally it may be advisable to remove tissue for microscopic examination, but in most instances I prefer to perform thoracotomy.

The greatest care should be exercised in the selection of cases for operation. Each patient should be subjected to the most rigid general examination with particular reference to the vital capacity of the lungs, the function of the heart and kidneys, and the possible existence of an associated organic or constitutional disease which may increase the operative risk. If the general examination reveals any associated organic or constitutional disease, it should be treated first. In the series of cases which forms the basis of this paper, two patients were treated for syphilis, one patient was treated for diabetes, and one was operated on for removal of a renal stone before the thoracic operation.

Patients who present operable intrathoracic lesions rarely demand emergency operations. I believe that all of these patients should be kept in the hospital under observation for 1 to 2 weeks before operation. The most common symptoms which demand any immediate treatment are dyspnœa and cyanosis. These are usually caused by increased intrapleural pressure, from the size of the tumor, from pleural effusion, or from both. Rest in bed is often all that is necessary to relieve these symptoms. If a pleural effusion is present the symptoms will be relieved by aspiration. If symptoms are due to the increased pressure caused by the tumor, administration of oxygen may be necessary. In 3 cases of the series repeated aspirations were made; before operation in one case it was necessary to administer oxygen.

The most important pre-operative preparation consists in induction of pneumothorax when possible 7 to 10 days before operation. In many cases this is not possible because of adhesions of the lung to the thoracic wall,

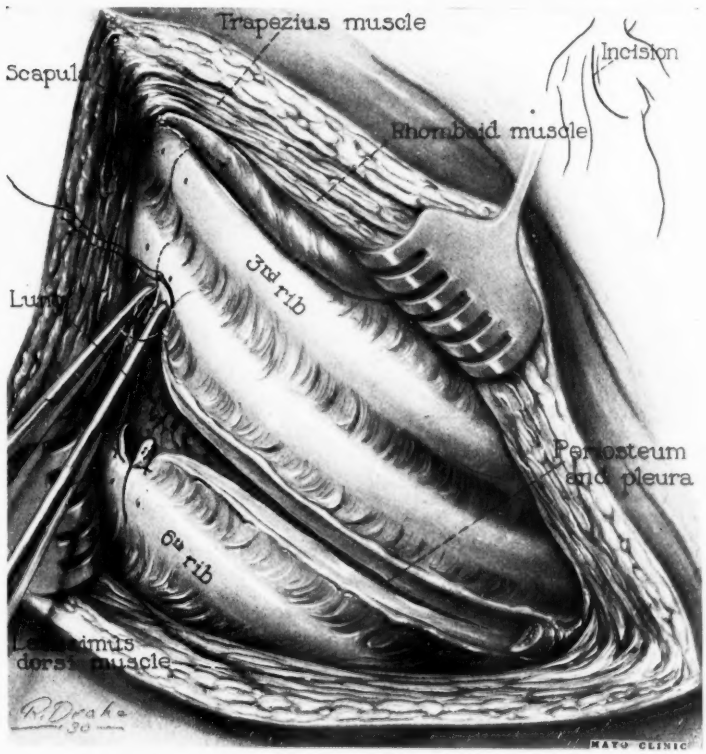


Fig. 3. Posterolateral incision along the vertebral border of the scapula and laterally along the seventh rib showing incision through the soft tissues of the thoracic wall and into the pleural cavity, with partial resection of the fifth rib. Intercostal vessels cut between ligatures and ribs drilled for reconstruction before the necessary ribs to increase the exposure are sectioned. The insert shows the site of incision.

either as a result of the existing disease or of some pre-existing inflammatory disease which involves the pleural surfaces of the lung and the thoracic wall. I think it advisable to induce the pneumothorax slowly, taking 3 to 5 days to complete the collapse of the lung. Preliminary pneumothorax is most desirable, as it permits the patient to become accustomed before operation to the altered intrapleural pressure associated with unilateral collapse. This is undoubtedly an added protection to the patient and decreases the immediate operative risk, for many of these operations are very severe, and a sudden condition of pneumothorax, produced at the time of operation, is often a great burden on the patient's powers of adjustment and resistance.

Most of the advancement that has been made in surgery of intrathoracic diseases has been accomplished because of the marked improvement in anæsthesia. The types of anæsthetic to be used vary with the condition of the patient and with the experience of the anæsthetist. In all cases of this series ethylene or nitrous oxide and oxygen were used.

The method of administration of the anæsthetic is of paramount importance, for the greatest immediate risk of intrapleural operations is the danger of open pneumothorax with collapse of the lung. This often produces severe respiratory and circulatory disturbances and may result in sudden death. These dangers, which have been the greatest obstacle to thoracic surgery, have been practically obvi-

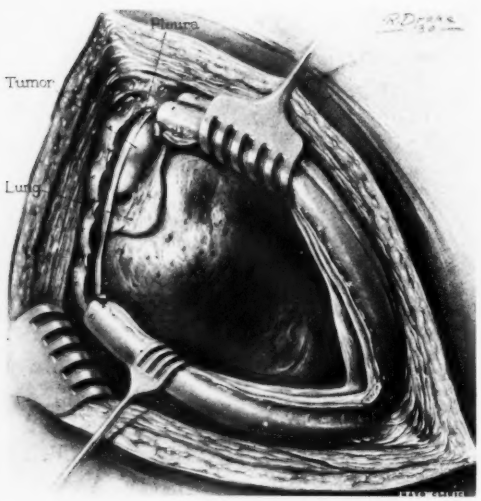


Fig. 4. Complete exposure by resection of the fifth rib and section of the third, fourth, and sixth ribs, showing large posterior thoracic and mediastinal tumor in the upper right portion of the thorax. The upper and middle lobes of the right lung are completely collapsed over the surface of the tumor. Beginning removal of the adherent lung from the tumor.

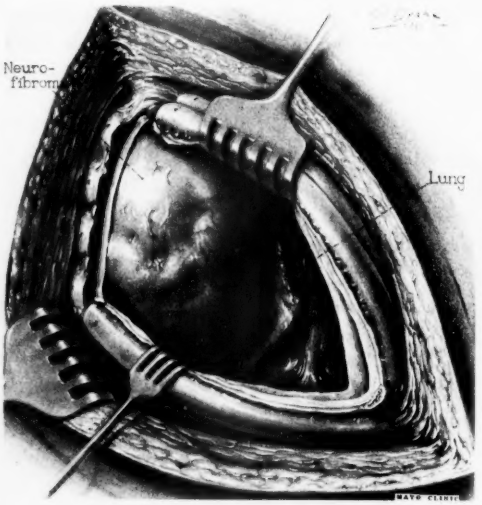


Fig. 5. Large posterior thoracic and mediastinal neuro fibroma after complete dissection of the adherent lung from its surface. Lung adherent to the parietal pleura.

ated by the use of differential pressure anæsthesia. This can be administered with a closed mask or by intrapharyngeal or intratracheal insufflation. If there is any possibility that both pleural cavities will be opened, intratracheal anæsthesia administered with a positive pressure apparatus is essential. Inasmuch as it is impossible before operation to determine when this may occur, either from accident or necessity, I believe that this type of anæsthesia should be used in most intrapleural operations.

The chief technical problems associated with surgical removal of these growths are as follows: (1) the difficulty of access through the bony encasement of the thorax and the necessity of selecting a method of approach which will give the greatest exposure of the tumor with the minimal amount of trauma to thoracic viscera and thoracic wall; (2) the dangers of traction on the vital structures in the mediastinum to which the tumor may be adherent; there is usually a marked fall in blood pressure and increase in pulse rate with symptoms of shock following traction produced by removing tumors that are adherent to the pericardium or great vessels at the base of the heart; and (3) the complete reconstruction of the thoracic cage that is advisable so as to restore the normal relations of the thoracic viscera and to give the minimal amount of deformity.

The entire operative procedure should be thoroughly planned for each case before the patient enters the operating room so that there is the least possible delay in the actual operation. The element of time is a significant factor in thoracic surgery. It is rarely advisable to keep the pleural cavity open more than 30 to 45 minutes because of the rapid loss of body heat and the severe strain on the cardiac and respiratory reserve. If it is necessary to cause collapse of the lung in the course of removal of an extrapulmonary lesion, it is advisable to inflate the lung every 3 to 5 minutes to re-establish the circulation and to avoid trauma to the parenchyma of the lung.

The method of approach of intrathoracic tumors depends on the situation of the growth. If the tumor is attached to the thoracic wall it is best to make the incision over the site of the tumor. If the tumor is in the anterior or posterior mediastinum or in the lung, I prefer to make a posterolateral incision between the

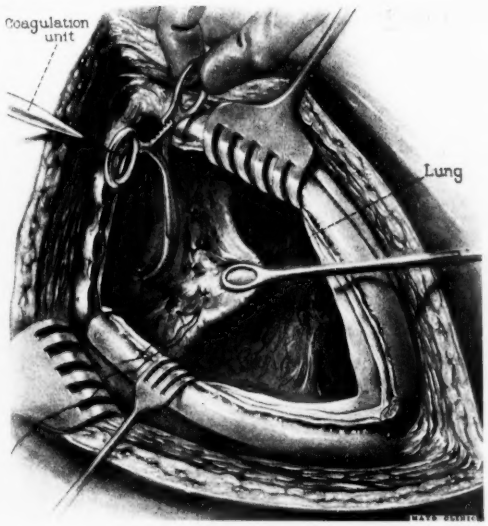


Fig. 6. Large cavity resulting from complete removal of the large posterior thoracic and mediastinal tumor. Lung partially collapsed. Repair of many areas of injury to the lung and using coagulation cautery for control of multiple bleeding points deep in the posterior mediastinum and on the surface of the lung.

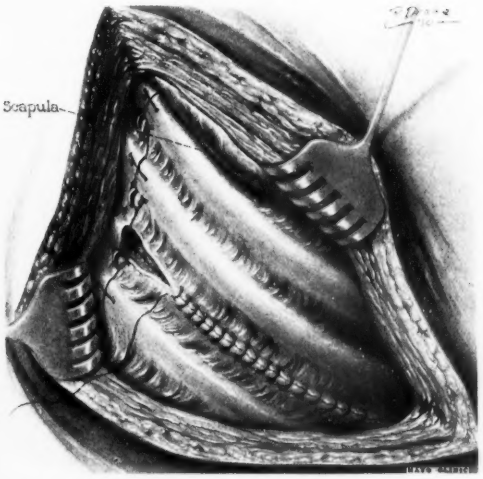


Fig. 7. Complete reconstruction of the thorac wall after removal of large posterior mediastinal tumor by transpleural operation. Ribs sutured with catgut. Muscles of thoracic wall closed in layers and thoracic cavity closed without drainage.

vertebral border of the scapula and the spinal column and to extend the incision laterally just below the angle of the scapula. The pleural cavity can be opened through the intercostal space or through the posterior periosteum after partial resection of a rib. The vertical position of the incision through the thoracic wall depends on whether the tumor is in the upper or the lower part of the thorax.

The type of operation depends, to some extent, on the lesion found and on the indications which are present in each case.

In the past 5 years I have performed transpleural operation in 28 cases of intrathoracic tumor. In this paper I shall give a brief summary of the entire series, including the types of tumors, the methods of their surgical removal, the postoperative complications, and the results to the present time. I am also reporting a recent case of mediastinal tumor to illustrate the usual posterior transpleural type of operation that I prefer in these cases. Of the entire series of 28 cases, pneumothorax was induced before operation in 18.

In 20 cases the tumor was completely removed in a transpleural operation of one stage. This, I believe, is the operation of choice for all tumors of the mediastinum, or those which involve the thoracic wall. In removing some tumors of the lung, it may be advisable to do an operation in multiple stages. In one case the tumor was completely removed by an extrapleural operation in one stage. This procedure I have attempted in several cases, but I believe it is rarely possible or advisable. In most instances, the pleura is so adherent to the tumor that the pleural cavity is ultimately opened, with the accompanying danger of open pneumothorax, and the wide separation of the pleura from the thoracic wall which is necessary during this procedure delays healing and produces excessive pleural effusion. In one case the tumor was completely removed by an operation in two stages. The first stage was directed at mobilization of the growth and fixation of the pleura to the thoracic wall. The tumor was removed at a second operation. The objective of the first stage of the operation was defeated in this instance because of the occurrence of an extensive pleural effusion which required repeated aspirations, and not only delayed the time of the second operation

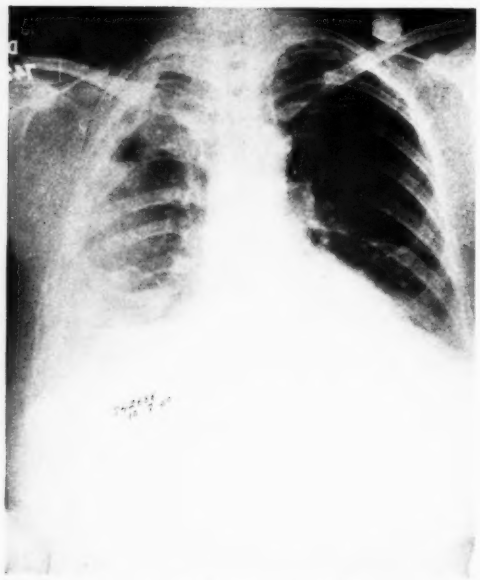


Fig. 8. One month after operation. Lung practically expanded. Some collapse at site of the tumor with slight thickening of the pleura.

but increased the operative risk. In 6 cases the tumor was partially removed by a transpleural operation in one stage. In all of these 6 cases there were extensive malignant conditions of the lung; the disease was found to be more extensive than it had been thought to be at the beginning of the operation, and infiltration into the thoracic wall and mediastinal structures made complete removal impossible.

The postoperative care is of utmost importance. There is usually considerable shock following operation, and every care should be directed toward minimal loss of body heat while the patient is on the operating table, and immediately after he returns to his room. The application of hot water bottles around the body and the introduction of hot saline solution by rectum are of value in maintaining body heat on the operating table. A large electric pad, covering the entire bed, is of great advantage after operation. When there has been much fall in blood pressure, most patients will require intravenous injection of saline solution which should be given very slowly. If there has been much loss of blood, transfusion of blood should be given. Dyspnœa and cyanosis may occur immediately after extensive operative procedures or as a late result of pleural effusion. They are treated by immediately placing the patient in an oxygen chamber. This is the most efficient method of administering oxygen, as the necessary general and special care can go on with the least amount of exertion to the patient. This often proves to be a life-saving procedure. Oxygen was administered to 12 of the 28 patients of this series.

In practically all cases, more or less severe pleural effusion develops. In approximately half of the cases, it is very mild and will not require aspiration, or at least not more than once. In the remaining half of the cases the pleural effusion may be severe and may require repeated aspiration; in a third to a half of these cases empyema may develop which will require drainage. Empyema usually occurs in cases in which it has been necessary to cut through the tissue of the lung to remove the growth; it occurs most commonly in cases of malignant tumors of the lung, or in cases in which there has been considerable trauma to the parenchyma of the lung, due to the removal of a large adherent tumor, most often following removal of teratomas or dermoids of the anterior mediastinum. In this series, repeated aspirations were required in 15 cases and in 5 cases acute empyema developed. In 4 of the patients in which empyema developed, benign tumor was present; in 3 dermoids, and in 1 case a fibroma. All the patients recovered.

The results to the present time, in the entire series of 28 cases, have been divided into two groups: those in which the condition was malignant and those in which it was benign.

In 14 cases there were malignant growths: 6 sarcomata, 2 endotheliomata, 4 adenocarcinomata, and 2 squamous-cell epithelioma. One patient died from the operation; 9 have died subsequently, due to recurrence. Four patients are still living.

The one operative death occurred on the seventh postoperative day, from cerebral embolism. The tumor in this case was a squamous-cell epithelioma; evidently it had been

a dermoid of the anterior mediastinum and had degenerated. Two patients with adenocarcinoma, who were subjected to partial lobectomy, lived less than a year, and died of recurrence. Of two patients with endothelioma, one lived less than a year and the other lived more than 2 years. Phrenicotomy was done in both of these cases to utilize the relaxed diaphragmatic muscle in the repair of the defect in the thoracic wall which resulted from removal of the tumor. In one of these cases it was necessary to remove a portion of the diaphragm which was involved with the tumor.

Five patients with sarcoma lived from 1 year to 2½ years after operation and died of recurrence. One patient with sarcoma is living for more than 5 years after operation, without evidence of recurrence. Two of these patients had been known to have tumors for several years before operation; evidently they had been benign but had undergone malignant degeneration. In the 2 other cases of sarcoma, the tumors were only partially removed because of extensive involvement of the thoracic wall and mediastinum, and both patients lived less than a year. One patient with squamous-cell epithelioma, which probably arose from degeneration of a dermoid of the anterior mediastinum, is living less than a year after operation. Two patients with adenocarcinoma, on whom partial lobectomy was done, are living less than a year after operation.

The end-results in these malignant cases, although not satisfactory, are probably as favorable as results obtained in operations on extensive malignant growths of high grade elsewhere in the body. They at least indicate that removal of malignant lesions from the thorax can be accomplished without serious operative risk, and they show the necessity of early diagnosis and institution of treatment before the lesion has extended beyond the possible limits of surgical removal. The clinical history and disclosures at operation in four of these cases indicated that the tumor was probably benign at the onset and had undergone malignant degeneration. In 2 of these cases the tumors were fibrosarcomas and in 2, squamous-cell epitheliomas; evidently they arose from degeneration of fibromata and dermoids. The possibility of malignant degeneration of benign growths is an additional important reason for early operation.

The operative results in the 14 cases in which the growths were benign were satisfactory. Twelve of the patients are living for from 1 to more than 4 years since operation. All have been completely relieved of symptoms, and there has been little, if any, disability or deformity as a result of surgical intervention. The histological examination of the tumors disclosed that 5 were neurofibromata; 2 fibromata; 4 teratomata; and 1 an osteochondroma. The enormous size that these benign tumors may attain often causes serious injury to thoracic viscera and increases the risk of operative removal. The possibility of malignant degeneration, particularly of fibromata and teratomata, is an additional reason for their early diagnosis and removal.

Two deaths were attributed to operation; both were from cardiac failure. One was directly due to surgical operation. The other, although it must be considered an operative death, could more justly be considered the result of delayed operation; the patient was *in extremis* from a huge tumor, which almost filled the thorax, and which was of several years' duration; myocardial degeneration and arteriosclerosis were associated; the systolic blood pressure was 240 millimeters of mercury. The condition of the patient and the urgency and magnitude of the procedure made operation hazardous. I believe that all of these patients should be operated on early, and that an operation in one stage is the procedure of choice.

The following report is of a recent case of posterior mediastinal tumor, with illustrations of the roentgenological findings and of the usual posterior thoracotomy and transpleural removal of the tumor in one stage.

REPORT OF CASE

A woman, aged 48 years, came to the clinic, June 9, 1930. She had been in good health until 9 months previous to her admission at the clinic, when a dull pain developed and was projected from the midsternal region, through to the upper right posterior portion of the thorax. This pain had been most marked on exertion and had been progressively more

severe. Dyspnœa on moderate exertion had been noted in the past few weeks. The patient also had a severe attack of pain over the left lower quadrant of the abdomen. This pain was projected through to the back and lasted for several hours. Morphine was necessary for relief. She had had numerous attacks, similar to this, since that time. The attacks varied in intensity and usually were associated with vomiting and burning on urination. She had lost 25 pounds in weight.

General examination was essentially negative except for dullness to percussion and absence of breath sounds over the upper part of the right lung. The systolic blood pressure was 188 and the diastolic, 94, measured in millimeters of mercury. Urinalysis gave negative results, except for the test for albumin. The concentration of hæmoglobin was 80 per cent. Leucocytes numbered 8,200 in each cubic millimeter of blood. The Wassermann reaction of the blood was negative.

Roentgenologic examination gave evidence of a large tumor in the upper right portion of the thorax, which caused marked collapse of the upper and middle lobes. The lateral view revealed that the tumor was in the posterior mediastinum (Fig. 1). Roentgenological examination of the kidneys, ureters, and bladder revealed a shadow in the pelvis of the left kidney.

Because of the prominence of the renal symptoms, it was thought best to consider the condition of the kidney first. Cystoscopic examination revealed a large, branched stone filling the pelvis and calices of the left kidney; there was moderate impairment of the function of the left kidney. Because of impairment of renal function it was thought advisable to remove the renal stone first, and left pelviolithotomy was done June 16, 1930. The patient was then permitted to go home and was advised to return to the clinic in 2 months for further consideration of the thoracic condition. At the time of her return, September 1, the result of the renal operation was found to be very satisfactory. The renal function was normal and the patient was entirely relieved of all renal symptoms. On re-examination of the thorax, it was found that there had been practically no change in the size of the thoracic tumor, as shown by general and roentgenological examination, and a diagnosis was made of large intrathoracic tumor of the upper right posterior portion of the mediastinum with almost complete collapse of the upper and middle lobes of the right lung (Fig. 2).

September 6, under intratracheal administration of ethylene and nitrous oxide, mediastinotomy was performed in the upper right posterior portion. Partial removal of the sixth rib and of sections of the seventh, fifth, and fourth ribs was accomplished, with complete transpleural removal of the tumor.

A posterolateral incision was made along the vertebral border of the scapula and about 14 centimeters of the sixth rib was removed. It was necessary to cut the seventh, fifth, and fourth ribs in order to expose the tumor, which occupied the entire upper right posterior part of the thoracic cavity and of the mediastinum. The upper and middle lobes of the right lung were almost completely collapsed and were very adherent over the surface of the tumor. It was necessary to cut through the tissue of the lung in several places while dissecting the lung from the tumor. These incised portions were resutured. There were many bleeding points in the lung, in which the bleeding was stopped by electrocoagulation. The lung was adherent to the thoracic wall below the tumor, and after the tumor had been removed there remained a large pocket, which extended into the posterior mediastinum over the body of the vertebra. The tumor had its origin at the level of the sixth interspace, posteriorly, close to the juncture of the ribs and spinous processes, and probably originated from the intercostal nerve at this point. The lung was fully inflated at the completion of the operation and the thoracic cavity was closed without drainage. The patient was given a transfusion of 500 cubic centimeters of blood before leaving the operating table. Microscopic study of the tissue revealed lipoid degeneration in a neurofibroma. The tumor measured 15 centimeters, 5 centimeters, and 7 centimeters in various diameters, and weighed 450 grams (Figs. 3, 4, 5, 6, and 7).

The patient's immediate convalescence was uneventful. The first roentgenogram, taken the day after operation, gave evidence of partial collapse of the lung at the site of the tumor, but no evidence of fluid. The second roentgenogram, taken on the second day after operation, showed evidence of a moderate accumulation of fluid at the site of removal of the tumor. The third roentgenogram, taken on the third day after operation, indicated the presence of a considerable amount of fluid, which necessitated aspiration on the fourth day because of symptoms of pain and dyspnœa. The patient required repeated aspiration over a period of 2 weeks. She ran a moderate septic temperature ranging from normal to 101 degrees F. The fluid became turbid, and on culture was found to contain streptococci. Therefore, a small catheter was inserted through the line of incision, for the purpose of irrigation. At present there is moderate collapse of the upper and middle lobes of the lung, at the site where the tumor was. Undoubtedly, this results from the trauma to the lung both from the pressure of the tumor and from the dissection necessary for its removal. The patient has been dismissed from the hospital and her condition is satisfactory (Fig. 8).

This case is of interest because of the importance of the removal of the renal stone first, thereby eliminating the possibility of any renal complication during the operative care of the thoracic lesion. Attention to the renal stone was made possible in this case because the thoracic symptoms, although they became progressively more marked, were not

severe enough to necessitate immediate treatment. The tumor was very large. The comparatively mild symptoms were due primarily to the type of tumor, which is benign, and to its situation in the upper posterior portion of the thorax and of the mediastinum. This may be termed the most silent area of the thorax; a tumor in this region may become very large without producing severe symptoms. The complicating factors of the pleural effusion and its becoming infected were the result of the destruction of the parenchyma of the lung due to the pressure of the tumor and to the trauma and cutting into the pulmonary tissue that was necessary during its removal. Although it was fortunate that the patient presented herself for examination and operation before either of the conditions became urgent and greatly increased the operative risk, I believe that the period of convalescence would have been shortened and less eventful, and that the operative result would have been more satisfactory had the tumor been removed before it had become so adherent to the lung and had caused so much destruction of the pulmonary parenchyma.

DISCUSSION

ALTON OCHSNER,[1] M.D., New Orleans: The two especial phases of thoracic surgery which I propose to discuss tonight are empyema and bronchiectasis. As emphasized by Dr. Lockwood, it is essential to differentiate between the synpneumonic and metapneumonic types of empyema in order that proper therapy may be instituted. In a series of 100 consecutive cases of acute empyema admitted to the Charity Hospital at New Orleans and recently studied by Dr. Gage and me, the mortality in the synpneumonic type was 29.5 per cent, whereas that of the metapneumonic type was 9.6 per cent, three times as high in the former as in the latter variety. The high mortality existed even though in most cases of synpneumonic empyema either aspiration or closed drainage had been used until the mediastinum had apparently become fixed and the pneumonic process had subsided. The type of pleural exudate varies in different types of pneumonia. A knowledge of the types of pleural exudate is extremely important as regards both prognosis and treatment. In the Charity Hospital series there was a 25 per cent mortality in those cases with a serous exudate, a 100 per cent mortality in those cases with hæmorrhagic exudate, and only a 6.4 per cent mortality in those cases in which the exudate was distinctly purulent. In the presence of either a serous or hæmorrhagic exudate, open drainage is absolutely contra-indicated as has been demonstrated repeatedly by various authorities.

No one type of treatment is applicable to all cases of acute empyema thoracica. In the Charity Hospital series in which the treatment was conducted by a large number of individuals without any concerted plan in mind, the following results were obtained by the various methods of treatment: From aspiration alone 41.7 per cent either completely or incompletely recovered, 25 per cent were unimproved, and 33.3 per cent died. From aspiration plus air injection 73.6 per cent either completely or incompletely recovered, 15.7 per cent were unimproved, and 10.7 per cent died. Following intercostal drainage 89 per cent either completely or incompletely recovered, none was unimproved, and 11 per cent died. Following rib resection 84.1 per cent either completely or incompletely recovered, 2.6 per cent were unimproved, 13.1 per cent died. As regards the after-treatment there was a distinct difference in the results obtained in the Charity Hospital series between those which were treated by open and those treated by closed drainage. Of those treated by open drainage 72.7 per cent recovered, 9.1 per cent were cured, making a total of 81.8 per cent either recovered or cured, 3 per cent were unimproved, and 15.2 per cent died, whereas in those treated by closed drainage 77.8 per cent recovered, 12.3 per cent were cured, making a total of 90.1 per cent either recovered or cured, none was unimproved, and 9.9 per cent died. Closed drainage resulted in a distinctly greater number of recoveries and cures and a smaller number of deaths. Cases of acute suppurative pleurisy should, however, be individualized. Unless adequate supervision is practiced, closed drainage will probably result in a higher mortality than open drainage, because the latter is more "fool proof." Open drainage is, however, less physiological than closed drainage and unless steps are taken to bring about a re-expansion of the lung, the lung may remain collapsed and the persistence of an infected pneumothorax may develop and persist—a rather frequent cause of chronic empyema.

The development of chronicity in empyema is especially to be avoided. Preventable causes of chronic empyema are delayed or inadequate drainage, persistence of pneumothorax, or fibrosis of the lungs, presence of foreign bodies, and osteomyelitis of the ribs. Unpreventable causes of chronicity are tuberculosis of the pleura and bronchopleural fistulæ. Tuberculous pleurisy occurred in 13 per cent of our cases, whereas pleural fistulæ occurred in only 3 per cent. This latter small figure is probably due to the fact that certain cases of pleural fistulæ were not recognized more frequently. The necessity for dependent drainage is a surgical axiom, and one of the most frequent causes of inadequate pleural drainage is failure to drain the most dependent portions. In cases of total empyema in order to secure dependent

[1] From the Department of Surgery, Tulane University School of Medicine, New Orleans, Louisiana.

drainage Nather and I advocated and have employed successfully drainage through the costophrenic angle by the resection of the twelfth rib.

In regard to Dr. Hedblom's paper on bronchiectasis; there are many causes of bronchiectasis, the most frequent of which, I am convinced, is a chronic, low grade infection of the bronchial tree. This, in turn, is secondary in a large majority of individuals, especially in children, to chronic infection of the nasal accessory sinuses, the infected material being aspirated into the tracheobronchial tree. From my experience it is evident that infection of the bronchial mucosa, i.e., bronchitis, precedes the bronchial dilatation in by far the majority of cases. It is also probable that there is primarily a functional dilatation of the bronchi and bronchioles and later the typical bronchiectatic lesion described by pathologists, i.e., dilatation, replacement of elastic tissue and musculature by fibrous tissue, occurs. A series of apparently normal students examined at the University of Wisconsin, all of whom complained of chronic bronchitis or were subject to attacks of acute bronchitis, were examined bronchographically. Ninety-five per cent of these young, normal individuals, complaining only of bronchitis, showed definite evidence of bronchial dilatation. Bronchiectasis occurs much more frequently than is generally supposed and is without any doubt the most frequent chronic pulmonary affection.

Little dependence can be placed on history and physical findings in early cases of bronchiectasis, because these are varied and often insignificant. Cough may be, and frequently is, the only symptom. The cough is usually productive, but the possibility of a "dry bronchiectasis" must always be considered. The diagnosis of bronchiectasis except those in the advanced stages can be made only by bronchography.

The treatment of bronchiectasis depends upon the severity of the lesion and the condition of the patient. Ideally, in the advanced cases of bronchiectasis, an extirpation of the diseased portion of the lung is the method of choice. However, because of the high mortality associated with such an operative procedure when performed as the usual lobectomy or cautery pneumectomy of Graham, this type of therapy is not applicable to the less advanced cases. Collapse, as suggested by Dr. Hedblom, is desirable in certain selected cases, but is hardly justifiable in the early cases and is probably only palliative in the more advanced cases, because of the rigidity of the bronchiectatic cavities, which resist collapse. In the early and the less advanced case no operative procedure is probably justifiable. It is especially in this case that the conservative treatment is of greatest value. Obviously in the advanced cases in which there is replacement of the elastic tissue and bronchial musculature by a scar transforming the bronchi and bronchioles into rigid tubes, conservative treatment can be only symptomatic. The conservative treatment consists of postural drainage and the repeated introductions of iodized oil into the tracheobronchial tree. The value of the conservative treatment is exemplified by the results obtained in 151 cases which have been treated either by my associates or by me. In 28.4 per cent a symptomatic cure was obtained. In 13 per cent of these a radiographic cure was obtained; 50.3 per cent were symptomatically cured, but had a recurrence of symptoms following a reinfection, which recurrence, however, responded to symptomatic cure with conservative treatment; 20.5 per cent were improved, but are still under treatment. The action of iodized oil in bronchiectasis, I believe, is twofold. It acts mechanically by displacing the bronchial secretions and facilitates expectoration. More important, however, is its bactericidal effect. We have been able to demonstrate that following the introduction of the iodized oil the number of organisms within the sputum, obtained by actual count, is decreased.

GEORGE P. MULLER, M.D., F.A.C.S., Philadelphia: The surgical treatment of diseases in the thorax now stands nearly on a par with the management of abdominal disease, although of comparatively recent development. Lesions of the heart and lungs, pleura, or mediastinum can be reached with comparative ease and an ever increasing safety. The surgeons who have read papers tonight are part of that group interested in thoracic surgery who have brought about much of the progress which enables us to treat these diseases successfully.

The surgical removal of tumors of the lung, pleura, or mediastinum is being attempted more frequently as shown by the fact that Harrington is able to report a series of 28 cases operated upon during a period of 5 years. It is true, as he says, that the roentgen ray is by far our most useful agent in the localization of a thoracic tumor and I believe that such an examination should be followed by another after the establishment of pneumothorax, if this is possible. Eloesser was the first in so far as I know, to call attention to the great importance of an induced pneumothorax before operation, habituating the lung to the pressure effect of the open chest. The idea seemed fanciful at first but it has taken hold. I rarely use endotracheal anæsthesia now, preferring to get the positive pressure with the gas mask. I notice that he prefers a posterolateral incision even if the tumor is located in the anterior mediastinum but I think that we can develop an approach through the sternum somewhat after the method of Duval-Barasty which will more easily reach the anterior growths.

Cancer of the lung parenchyma should be easy of removal if gotten early enough to enable partial lobectomy to be done, but cancer in the bronchus will require desiccation and radium treatment through the bronchoscope.

Abscess of the lung, if single and in the parenchyma, is no doubt embolic in origin in most cases or residual to a pneumococcic suppuration. It is only necessary to determine if such an abscess can be emptied by the patient through the bronchial

system to reach a decision as to treatment. With good drainage possible by posture, and the efficient use of the bronchoscope to "keep the drainage tube clean" many patients will make a good recovery without other treatment.

If no drainage can occur, no changes will be seen in the shadow shown by X-ray and no fluid level, and there will be persistent septic symptoms, hence it is futile to suggest anything except external drainage.

Suppurative bronchiectasis is an entirely different proposition and Hedblom very clearly points out how it develops. I had expected to see a greater incidence of this disease as a result of the great epidemics of "flu" pneumonia. It may be that the lung fibrosis is not sufficient to disturb the pressure relations in the absence of a destructive inflammatory process, or as Hedblom states, a fixation of the chest walls may diminish the dilating effect of inspiration on the shrunken lung. Hedblom's description of the clinical aspects, with emphasis on the chronic cough with purulent sputum as the key symptom and his statement that X-ray rarely shows any characteristic lesion unless reinforced by contrast media, deserves particular attention.

In the treatment of a definitely unilateral lesion fairly widespread in extent I think that his plan of phrenic neurectomy followed by graded thoracoplasty should be adopted. If the lower lobe alone seems involved by a limited process I would prefer to consider lobectomy without thoracoplasty, or at least after a thoracoplasty of the Sauerbruch type. As he says, cautery extirpation is particularly indicated in advanced extensive lesions and if this is attempted the primary exposure should be as large, almost, as the area to be extirpated. I believe that I have erred more frequently in making a too small exposure in the first stage operation for lung abscess or suppuration than to have feared that it was too large. With a large opening the deft use of the cautery unroofs the cavity and enables a light gauze pack to stimulate discharge and healing better and more safely than do rubber tubes. The multiple cavity variety, the bronchiectatic abscess as it is so frequently termed, cannot be drained adequately unless converted into a wide deep hole by the cautery.

Empyema is an interesting condition, thoroughly understood, easily diagnosed, treated by simple technique, and yet with a rather high mortality rate, which has led so many into the pitfalls of technical argument. The cavity must be emptied of its pus and kept drained. The lung must be brought out to the chest wall. If the drainage has been done sufficiently early and is adequate, the exudate easily clears up, and the lung fills out if respiration through the drainage tube is prevented. There is no special trick to it. If one waits for the subsidence of the pneumonia, operates in the meta pneumonic stage, empties the cavity gently, and stimulates resistance the mortality of the disease will be quite low provided that complications of infection elsewhere do not occur or that the streptococcus in diffuse infection is not the causative agent. There is too much argument about small technical affairs in the treatment of empyema.

EXPERIMENTAL EFFORTS TO TRANSFER MONKEY MALARIA TO MAN

HERBERT C. CLARK, M.D., PANAMA
Director, Gorgas Memorial Laboratory
AND
LAWRENCE H. DUNN, PANAMA
Medical Entomologist and Assistant Director, Gorgas Memorial Laboratory

A PRELIMINARY report[1] on malaria in wild monkeys of Panama was made about one year ago but no success attended efforts to secure an unharmed living specimen of a monkey carrying the disease. A later expedition has been made that did secure, in an unharmed condition, six juvenile and two infant monkeys with malarial infections. These animals were caught in the uninhabited portion of Panama known as the Coto region and they were brought to the Gorgas Memorial Laboratory and placed in screened quarters.

Several experiments in efforts to transfer monkey malaria to man and human malaria to the monkey have been made in the Eastern hemisphere but they produced refractory results or were surrounded with circumstances that seemed to leave the question in doubt. In view of the fact that our Western hemisphere monkey malaria is difficult if not impossible to distinguish from human quartan and tertian malaria and that our monkey malaria might also be different from that of the Eastern hemisphere, it seemed wise to repeat such experiments.

We secured for our tests eight human volunteers who were young men (18 to 22 years of age) that had lived in the most northern part of the United States where malaria is not endemic. These men had never been in an area where malaria existed until they arrived on the Isthmus of Panama. It is true they had lived on the Isthmus from 7 to 14 days before the tests were started but they were housed under the best local conditions available for their protection from a malarial infection.

Direct methods employed. Seven of the men were given subcutaneous injections of parasitized monkey blood (½ to 2 cubic centimeters) and 5 of the men, in addition, were given 1 cubic centimeter of similar blood intravenously.

Indirect method employed. All of the 8 men were bitten with mosquitoes that had fed on the parasited monkeys. Our local mosquito carriers of human malaria were used in this effort.

A.[2] tarsimaculatus was used on A.D. who received 25 bites over a period of time from March 20 to April 1, 1930.

A. tarsimaculatus was fed on A.A.R. who received 28 bites from March 30 to April 7, 1930.

A. tarsimaculatus was fed on E.C.C. who received 28 bites from March 30 to April 7, 1930.

A. albimanus was fed on C.R.G. who received 45 bites from March 19 to March 26, 1930.

A. albimanus was fed on O.A.D. who received 21 bites from March 27 to April 7, 1930.

A. pseudopunctipennis was fed on J.H.K. who received 30 bites from March 19 to April 1, 1930.

A. pseudopunctipennis was used on R.F.A. who received 19 bites from April 1 to 7, 1930.

A. argyritarsis was used on H.J.B. who received 15 bites from March 26 to April 7, 1930.

Mosquitoes dissected 3 weeks after feeding on monkey malaria revealed positive glands in 2 of 18 A. tarsimaculatus, 1 out of 7 A. albimanus and none out of 11 A. pseudopunctipennis and 4 A. argyritarsis.

Results of human experiments. The results were negative with the possible exception of the test on A.D. who received no direct blood effort to transfer the disease. He was bitten 25 times by A. tarsimaculatus from March 20 to April 1, 1930, and on the second of April developed an elevation of temperature to 100.6 degrees associated with chilly sensations, and was inclined to keep to his bed most of that day. He had several elevations of temperature thereafter at or near 100 degrees but no satisfactory symptoms developed. On April 17 and May 7 he showed one or two intracorpuscular forms that we consider to be

[2] Anopheles.

[1] An abstract of paper presented before the Clinical Congress of the American College of Surgeons, Philadelphia, October 13–17, 1930. Published in detail in Am. J. Trop. Med., January, 1930.

malarial parasites but there was never a satisfactory laboratory finding in his blood films.

Results in control animals of the experiment. A juvenile black spider monkey and a juvenile white face monkey that had spent most of their lives in captivity and whose blood films had been negative for parasites over several weeks' observation were given direct blood injections at the same time and from the same animals used on the men. Both of these monkeys developed attacks of malaria on the eleventh day following the injections. The black spider monkey died on the forty-eighth day of the disease even in the presence of quinine treatment. The white face monkey recovered spontaneously but even now shows a few parasites in its blood films from time to time.

CONCLUSIONS

We conclude from these experiments that our red spider monkey malaria and the local human benign species of malaria are probably not identical and our monkeys are not, therefore, a reservoir for human malaria. Two control monkeys of different species from the red spider monkey developed acute attacks in 11 days while no satisfactory symptoms or laboratory findings developed in 8 men representing the best type of non-immune human subjects. It remains to be seen what may happen when an infant monkey (born free of opportunities to acquire monkey malaria) is inoculated with human malaria of the benign species. Circumstances indicate, however, that it will not acquire the disease.

The knowledge gained by these experiments offers one practical feature. The infant and juvenile monkeys of certain species (Ateles and Cebus) offer a better animal for research in malaria than the bird which is customarily used.

It is also interesting to note that two specimens of A. tarsimaculatus and one of A. albimanus fed on monkey malaria showed positive glands on dissection. Further work on efforts to transfer by this means between monkeys is in progress since it may afford a means of providing teaching material of this character.

REFERENCE

CLARK, HERBERT C. A preliminary report of some parasites in the blood of wild monkeys of Panama. Am. J. Trop. Med., 1930, x, Jan.

THE STERILITY OF CATGUT IN RELATION TO HOSPITAL INFECTIONS

With an Effective Test for the Sterility of Catgut[1]

FRANK L. MELENEY, M.D., and MABEL CHATFIELD, New York
From the Bacteriological Research Laboratory of the Department of Surgery, College of Physicians and Surgeons, Columbia University and the Presbyterian Hospital, New York

In a previous communication (25), we indicated the importance of being able to depend upon the sterility of catgut. The common use of catgut in all surgical clinics, makes this a question of general interest. The fairly recent occurrence of two series of wound infections, in two New York hospitals, traced to catgut which had not been properly sterilized (26), led the writers, 3 years ago, to review this problem, with the purpose of improving the situation if possible. We brought out the fact that the catgut firms had developed various and sundry methods for producing suture material and competed with one another in the matter of tensile strength, flexibility, absorbability, and even sterility. It is almost self-evident that in the matter of sterility there should be no competition, and those catgut firms which cannot put out sterile goods should be driven from the field. It is evident, however, that they continue to do business, at the present time. In a recent study of 174 specimens of catgut sent us by 12 different surgical clinics, scattered throughout the country and either taken from their stocked supply or purchased from the open market, 22, or 12½ per cent, were found to yield sporeforming bacteria, including the common gas-gangrene organisms (Table I). The specimens were labeled with the names of 17 different catgut manufacturers or distributors, except 8 which had no labels. All were sealed in glass tubes. The specimens from 10 firms yielded no growth, while the products of 7 firms and the unlabeled tubes showed growth ranging from 5 per cent to 67 per cent of the specimens which were tested. It may readily be seen that our percentage of contaminations would have varied considerably if we had varied the proportion of specimens from certain of the firms. In every instance the organisms found were sporeformers and not pyogenic cocci, indicating that the more susceptible organisms had been destroyed in the "sterilization" process. We guarded against contaminating our cultures with air-borne organisms during the tests by making all transfers in a "dust proof" chamber. A recent report in the German literature has recorded a study of surgical catgut yielding 80 per cent of contaminations (19). Last fall an exhaustive report appeared from the British Medical Research Council on "The Preparation of Catgut for Surgical Use." It was based upon the work of Bulloch, Lampitt, and Bushill, and covered a period of 7 years. They demonstrated the frequent contamination of catgut purchased on the market and proposed a standard method for testing for sterility, which the British government has since made a legal requirement for all catgut firms. We were very much pleased to find that this important work was being carried on parallel with our own and it gave us a basis for comparison which will be mentioned below. At present there is no authority in this country demanding sterility of catgut. We hope that eventually, we too will have government control. But we already have an authority within the medical profession, namely, the Hospital Standardization Committee of the College of Surgeons, available and willing to bring about the desired result. They are sponsors for our present study.

In our study we have not been concerned with the methods of preparation or of sterilization, important as these are. We are perfectly willing to leave these methods to the individual firms. After all, the final check up is the important thing. We only want to be as sure as we can possibly be that the final product is sterile. It seemed to us that the best way to solve the problem would be to develop a standard test for the sterility of the final product, which would be efficient, practical, and acceptable to the honest catgut firms. If this were used to test every batch of catgut put through the sterilizing process, and if the American College of Surgeons demanded its use by catgut firms whose products they approved, the desired result might be obtained.

We pointed out in our earlier paper that such a test would have to be based upon the knowledge of the best cultural methods for the growth of the bacteria commonly found in raw catgut, particularly those most difficult to destroy by means of heat or chemicals; namely, the sporeforming organisms. In our previous paper we gave the results of a bacterial study of raw catgut and

[1] Presented before the Clinical Congress of the American College of Surgeons, Philadelphia, October 13–17, 1930.

showed that the 3 most common gas-gangrene organisms may be present. True tetanus bacilli were not found but we must assume that at times they are present for there seems to be definite proof that they have been found in catgut on other occasions (20). We also showed that combinations of organisms, of themselves non-pathogenic, in symbiosis might become so, demonstrating the fact that any organisms present in catgut may be a menace to the health or the life of a patient in whom it is used.

Following the study of raw catgut, steps were taken to find a method by which it could be definitely determined whether or not these organisms had been destroyed by the various sterilization processes to which the catgut had been subjected when prepared for surgical use. There are three principal methods of catgut sterilization in common use today by the supply houses—one is with heat, another is with chemicals, and the third is a combination of these two. Certain organisms such as the pyogenic cocci are readily killed by relatively low degrees of heat which do not impair the physical properties of the catgut; others, such as the gas-gangrene organisms and tetanus bacilli, form spores which are destroyed only by degrees of heat which approximate closely the temperatures that alter the physical properties of the catgut and render it unfit for surgical use. The margin of safety in this zone is relatively narrow so that great care must be taken to maintain the heat for a definite length of time within a narrow range of temperature. The pyogenic cocci are relatively easily destroyed with almost any sterilization process in which heat is used and when catgut, which has been subjected to heat, is not actually sterilized it is found that the organisms which grow out are the sporeformers and not the pyogenic cocci. We doubt very much if wound infections are often due to pyogenic cocci contained in the catgut used. When chemical methods are employed the problem is somewhat different; but the principle is essentially the same. Certain chemicals, unquestionably, render certain bacteria incapable of growth and multiplication. These chemicals may be bactericidal, that is, they may actually destroy organisms. Certain other chemicals inhibit the growth of bacteria but do not actually render them non-viable. Such an action is called bacteriostatic. When such a chemical is removed the organism may be made to proliferate. Certain chemicals are bactericidal for some organisms, bacteriostatic for others, and have no effect whatsoever on others. Up to the present time the chemicals which have been used in an attempt to sterilize the organisms of catgut, have given disappointing results, particularly when the search has been made for one having bactericidal effect upon many different species, and most of them have been particularly weak in their action against the sporeforming organisms. Although the time may come when a chemical bactericidal substance will be found which is reliable, at present it would seem that the heat method of sterilization is superior to any chemical method now available. Contact of catgut with heat or chemicals results in a penetration of the catgut by the sterilizing agent. The organisms in the innermost parts of the gut may survive, if they do not come in contact with an effective degree of heat or an effective concentration of the chemical for a sufficient length of time. When such catgut is used surgically, the liberation of those organisms will not take place until the outer surfaces have been absorbed.

TABLE I.—STERILITY TESTS WITH ONE HUNDRED AND SEVENTY-FOUR SPECIMENS OF CATGUT SENT US BY TWELVE SURGICAL CLINICS IN ELEVEN DIFFERENT STATES TAKEN FROM THEIR STOCK SUPPLY OR PURCHASED IN THE OPEN MARKET

Source	Tested	Contaminated	Per cent
Firm I	38	0	0
Firm II	35	2	6
Firm III	20	1	5
Firm IV	10	3	30
Firm V	3	0	0
Firm VI	1	0	0
Firm VII	11	3	27
Firm VIII	3	0	0
Firm IX	2	0	0
Firm X	2	0	0
Firm XI	11	0	0
Firm XII	6	4	67
Firm XIII	2	0	0
Firm XIV	1	0	0
Firm XV	8	2	25
Firm XVI	5	0	0
Firm XVII	8	5	63
Firm ?	8	2	25
Totals	174	22	12.5

MEDIA

In testing catgut for sterility a medium must be used which is favorable for the growth of anaerobic sporeforming bacilli of which clostridium novyi (bacillus œdematiens) is probably the most fastidious. Since study began in the field of anaerobic bacteriology, workers have applied themselves to the understanding of the differences between aerobic and anaerobic bacteria and the special conditions required by the latter for

their growth and multiplication. From time to time the progress in this field has been reviewed, notably by Roux, Novy, and Hunziker. Still more recently Hall has covered this ground in the report which appeared in 1929. Hall brings out the fact that the numerous methods, which have been suggested for cultivating the obligately anaerobic bacteria, involve, as a rule, a combination of some method of reducing oxygen tension and some method of maintaining this reduction of oxygen tension, in addition to supplying the necessary nutrient materials. Oxygen tension may be reduced by biological, physical, or chemical agents and may be maintained by an efficient sealing of the media itself or the container holding the whole culture apparatus. In testing large numbers of specimens of catgut it is requisite to simplify the apparatus and technique as much as possible without sacrificing efficiency. For that reason the various biological methods of reduction are unnecessarily elaborate. The use of animal tissues in the media often makes it difficult to determine grossly the presence or absence of growth in the culture tubes, and the solid or semisolid media may not permeate the innermost parts of the catgut.

Forty years ago Kitasato and Weyl showed that glucose served both as a reducing agent and as a nutrient adjuvant to media. A few years later Novy studied glucose and other ingredients in relation to anaerobic growth. He found that glucose 1 to 2 per cent, gelatin 2 to 5 per cent, and litmus, all had valuable reducing properties and that litmus further served as an indicator of the degree of the oxygen tension in the medium. The theory of M'Leod and Gordon (11) that peroxides, forming in the media, prevent the growth of anaerobes unless peroxidases are supplied to counteract their effect, has not been conclusively proved. This may be only one of the factors in the oxidation reduction balance. A low oxygen tension may be maintained by an impervious seal which prevents the access of atmospheric oxygen and thus permits the reducing function of the ingredients of the media to continue their action. When the reducing substances are not optimal or the seal is not complete large inocula may yield growth because of the reduced oxygen tension produced by a death of part of the inoculum. When we culture catgut which has been put through a "sterilizing" process, we must assume that the inoculum of organisms is an extremely small one. At the same time it is possible that catgut itself acts as a reducing agent to some degree and counteracts to a certain extent the unfavorable factor of the small inoculum of organisms. Recently, Dubos has found that boiling the media just before use not only reduces it by driving off the oxygen but alters the oxidation-reduction system in such a way as to maintain a favorable reduction potential for several hours. He has found that much smaller inocula will grow in media recently boiled than in media which have not been so treated.

All of the points which we have mentioned must be taken into account in our search for an ideal medium to test the sterility of catgut. To sum it up, the medium of choice for our purposes is a clear fluid medium containing the necessary nutrient materials, adjusted to the optimum hydrogen-ion concentration and containing the necessary reducing substances,—a medium which may be boiled, inoculated quickly, sealed with an impervious seal, and incubated for a long time. The test of efficiency for such a medium is the growth of the most fastidious anaerobes (for example bacillus œdematiens) when planted in very high dilutions of the inoculum.

In our search for a medium we first inquired the technique of four of the catgut firms. We found that the ingredients of their media were all somewhat different. Only one of the four took into account the necessity for reducing substances in the medium and all of them used albolene as a seal. As stated in our previous report, having confirmed the demonstration of previous workers that liquid albolene permitted the passage of oxygen, we recommended to the catgut firms as the first step in the improvement of their technique, the substitution of vaseline or equal parts of vaseline and paraffin instead of the oil. Then we compared the four media by planting high dilutions of bacillus œdematiens and found that that of Firm II containing the reducing substance, glucose (with one unimportant exception), gave growth to higher dilutions of inoculum than any of the others. After that we compared these media by inoculating with diluted cultures of several other anaerobes with approximately the same result (Table II). Finally we took the best of these 4 media, namely, that used by Firm II and compared it with 4 other media particularly recommended for anaerobic growth. These media were (a) the gelatin, glucose, litmus medium of Novy which has stood the test of time as a good anaerobic medium and fulfills the fundamental requirements by containing active nutrient and reducing elements; (b) the casein digest medium originally advocated by Wolf and later used successfully by Henry and Kahn (16). (In a personal communication from Kahn we learned that higher percentages of casein digest substance even up to 50 per cent were more effi-

TABLE II.—COMPARISON OF MEDIA USED BY FOUR CATGUT FIRMS IN THEIR STERILITY TESTS. THE RESULTS ARE GIVEN WITH ALBOLENE AND WITH VASELINE SEAL

Cult. dil.	Bacillus œdematiens								Vibrion septique							
	Albolene seal				Vaseline seal				Albolene seal				Vaseline seal			
	Firm I	Firm II	Firm III	Firm IV	Firm I	Firm II	Firm III	Firm IV	Firm I	Firm II	Firm III	Firm IV	Firm I	Firm II	Firm III	Firm IV
1	−	−	−	−	+	+	+	+	−	−	−	−	+	+	+	+
2	−	−	−	−	+	+	+	−	−	−	−	−	+	+	+	+
3	−	−	−	−	−	+	+	−	−	−	−	−	−	+	+	+
4	−	−	−	−	−	+	−	−	−	−	−	−	−	+	−	+
5	−	−	−	−	−	−	−	−	−	−	−	−	−	+	−	−
6	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−
7	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−

Cult. dil.	Bacillus welchii								Bacillus sordellii							
	Albolene seal				Vaseline seal				Albolene seal				Vaseline seal			
	Firm I	Firm II	Firm III	Firm IV	Firm I	Firm II	Firm III	Firm IV	Firm I	Firm II	Firm III	Firm IV	Firm I	Firm II	Firm III	Firm IV
1	−	−	−	−	+	+	+	+	−	−	−	−	+	+	+	+
2	−	−	−	−	+	+	+	+	−	−	−	−	−	+	+	+
3	−	−	−	−	+	+	+	+	−	−	−	−	−	+	+	−
4	−	−	−	−	+	+	+	+	−	−	−	−	−	+	−	−
5	−	−	−	−	+	+	+	−	−	−	−	−	−	−	−	−
6	−	−	−	−	−	−	+	−	−	−	−	−	−	−	−	−
7	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−

In this and in other tables the culture dilutions used for inoculation are decimal,— each containing a tenth of the organisms of the preceding dilution.
+ Indicates growth. − Indicates no growth.
Firm II contained a reducing substance—the others did not.

cient than the original 2 per cent); (c) the cooked meat medium of Holman (modified slightly) which we have used very satisfactorily for all of the pathogenic anaerobes for several years; and (d) the "sloppy agar" medium advocated by Bulloch, Lampitt, and Bushill in their extensive report on the preparation of surgical catgut referred to above. With the 3 clear fluid media we used a vaseline or "vaspar" seal. The meat medium we incubated in the McIntosh and Fildes anaerobic jar as a control. Bulloch recommends the use of the "sloppy agar" medium without a seal of any kind, depending upon the physical state of the medium and the reducing substances in it to give sufficient anaerobiosis. He does not give any basis of comparison between this and other media.

We compared all of these media by inoculating 0.1 cubic centimeter of progressive decimal dilutions of the various pathogenic anaerobes. It was soon apparent that the "sloppy agar" without a seal would not yield growth from the higher dilutions of inocula and even with a seal it did not prove to be as favorable as the other media. This is shown in Table III. The 4 other media were then compared by inoculating with dilutions of cultures of the pathogenic anaerobes varying in age from 1 to 4 weeks. The results of this test are given in Table IV. On the whole, the meat medium gave the best results, but the gelatin glucose was the best of the clear media and its superiority to the others was more clearly demonstrated when chemicals and chemical neutralizers were added to the media as shown in Table V. This will be discussed more fully below. Adding cysteine to the gelatin glucose medium to represent the SH group of reducing agents did not improve the results.

Although the gelatin glucose medium was the most favorable of all which we tested, we cannot help feeling that it is probable that a still better medium may be found. The studies which are being carried on by Clark, M'Leod (24), Dubos, and others in the field of the reduction potential of various media suggest that still more favorable environment for anaerobic growth will be discovered. The ultimate proof of an ideal medium would be its ability to yield growth following the inoculation of a single bacterium. When individual organisms are picked up in a microscopic capillary pipette from a diluted culture by the Barber (1) or Chambers or other similar technique and are transplanted into fresh media they may or may not germinate depending upon whether they have an inherent capacity for growth and whether they can adapt themselves to the environment of the medium. A very high percentage of individual organisms from certain cultures, such as bacillus coli, will grow out when

TABLE III.—COMPARISON OF NOVY'S MEDIUM (GELATIN) WITH THE BRITISH MEDIUM ("SLOPPY AGAR") WITH AND WITHOUT A "VASPAR" SEAL

Cult. dil.	Vibrion septique			Bacillus œdematiens		
	Gel.	Agar	Agar sealed	Gel.	Agar	Agar sealed
1	+	−	+	+	−	−
2	+	−	+	+	−	−
3	+	−	−	+	−	−
4	+	−	−	+	−	−
5	+	−	−	+	−	−
6	−	−	−	−	−	−
7	−	−	−	−	−	−
8	−	−	−	−	−	−

they are transplanted in this manner—some quickly and others more slowly as Burke and others have shown. With other bacterial cultures, such as the anaerobic sporeformers, this percentage of "takes" is very much lower. Kahn (17) found that with the casein-digest medium which he used, he was never able to recover more than 15 to 20 per cent by his individual transplantations. Barber (2) obtained about 15 per cent of "takes" when he transplanted individual vegetative forms of anaerobes and about 30 per cent with spores. After spending several months in perfecting the technique of picking up individual organisms we had to abandon the method because in no media which we could find would the anaerobes grow in a sufficiently high percentage to furnish satisfactory ground for the comparison of the media. It is of interest to recall that Barber (3) succeeded in producing disease only by the inoculation of single organisms into animals when he was dealing with unusually virulent organisms such as bacillus anthracis or plague bacilli. It might be argued, on this basis, that the complete sterilization of catgut is unnecessary and that it does not matter if a few of the gas-gangrene organisms are introduced into the wound with catgut. It is probably true that contaminated catgut has been used again and again without producing infection, but what surgeon would willingly introduce even a few gas-gangrene organisms into his patient? When transferred to our culture media, a much smaller number of gas-gangrene organisms will grow than is sufficient to kill a mouse, but we cannot be sure that the same dose in a wound where there has been death of and trauma to tissue would not produce disease in man. It is obvious that only absolute sterility of the catgut so far as it can be determined by test, and not a relative sterility, must be the standard. Until the time comes when

TABLE IV.—A COMPARISON OF FOUR DIFFERENT MEDIA INOCULATED WITH DECIMAL DILUTIONS OF THE SIX MOST IMPORTANT SPORE-FORMING ORGANISMS TAKEN ONCE A WEEK FROM CULTURES GROWING FOR ONE MONTH IN MEAT MEDIUM IN AN ANAEROBIC JAR

Media	Bacillus welchii				Bacillus œdematiens			
	Age of culture				Age of culture			
	1 wk.	2 wks.	3 wks.	4 wks.	1 wk.	2 wks.	3 wks.	4 wks.
Gelatin	5	5	3	4	3	3	4	3
Casein	6	5	4	4	3	3	2	2
Firm II	4	4	3	3	4	4	4	3
Meat	6	5	4	4	6	6	3	3
	Vibrion septique				B. histolyticus			
	Age of culture				Age of culture			
	1 wk.	2 wks.	3 wks.	4 wks.	1 wk.	2 wks.	3 wks.	4 wks.
Gelatin	4	4	4	4	7	7	7	7
Casein	5	6	4	4	7	7	7	7
Firm II	3	4	4	3	6	6	5	6
Meat	5	7	6	5	7	7	7	7
	Bacillus sordellii				Bacillus tetani			
	Age of culture				Age of culture			
	1 wk.	2 wks.	3 wks.	4 wks.	1 wk.	2 wks.	3 wks.	4 wks.
Gelatin	5	6	5	6	6	5	4	4
Casein	5	5	5	5	6	5	4	4
Firm II	3	4	5	5	5	3	4	4
Meat	7	7	6	6	5	5	5	4

The figures in the columns represent the highest decimal dilution of inoculum which yielded growth after transplantation.

a method shall be found which will yield growth in 100 per cent of cultures made from individual spores, we cannot consider that any test is an absolute criterion of sterility. We can only say of our test, that it is the best method that we know and thus leave the road open for further progress toward the ideal.

HYDROGEN-ION CONCENTRATION

It is well known that different bacteria prefer different levels of hydrogen-ion concentration as the optimum for their growth. Having determined that gelatin medium gave the best results at the ordinary reaction (pH. 7.6) we ran the gas-gangrene organisms and tetanus through a series of different hydrogen-ion concentrations in this medium, testing the viability of the organisms in a series of high dilutions. The results are shown in Table VI. We found that certain of the gas-gangrene organisms grew out satisfactorily in a fairly wide zone of hydrogen-ion concentration

TABLE V.—COMPARISON OF MEDIA CONTAINING 0.5 C.CM. OF 1–2,500 POTASSIUM MERCURIC IODIDE WITH AND WITHOUT THE NEUTRALIZERS 1 PER CENT SODIUM THIOSULPHATE AND 1 PER CENT SODIUM CARBONATE

Cult. dil.	Without neutralizer			With neutralizer			Control Meat
	Gelatin	Casein	Firm	Gelatin	Casein	Firm	
1	+	−	+	+	+	+	+
2	+	−	+	+	+	+	+
3	+	−	+	+	+	+	+
4	+	−	−	+	−	+	+
5	+	−	−	+	−	−	+
6	−	−	−	+	−	−	+
7	−	−	−	+	−	−	+
8	−	−	−	+	−	−	+

while others were more strict in their demands. It was found that a hydrogen-ion concentration of 7.2–7.4 was optimum for most of the important anaerobes. This corresponds closely with the findings of Kahn (16) and others. This is slightly more alkaline than the optimum for the acidophilic organisms and slightly more acid than the optimum for the pyogenic cocci. It would seem, however, for purposes of our test that it would be best to use the hydrogen-ion concentration optimum for the most important of the organisms suspected; namely, the sporeforming anaerobes. At these levels most of the other organisms will grow satisfactorily.

ANAEROBIOSIS

We confirmed the findings of Hall (12), and Gates and Olitsky, and others with respect to the permeability of liquid albolene for oxygen and with respect to the impermeability of vaseline or a mixture of equal parts of vaseline and paraffin. Paraffin alone retracts from the glass tube when it cools and permits the passage of air. We prefer the "vaspar" to vaseline alone, for the latter may melt with prolonged incubation and in that state permit oxygen to pass. We have shown that oxygen will pass through an oil seal from without inward and cause the color to return in reduced methylene blue or from within outward when the oil-sealed tube with oxidized indicator is placed in an anaerobic jar. We have also demonstrated that dilute inocula of several anaerobes will not grow under an oil seal while they will do so under vaseline or "vaspar." This is shown in Table VII.

The vaseline seal may be added before the final sterilization of the media and melted just before inoculation but it is better to add it to the media after inoculation. The disadvantage of the former method is that when catgut is inoculated into a tube through a melted vaseline seal it becomes coated with the vaseline, which may render it impervious to the media and thus prevent organisms within the gut from coming out into the media. Before inoculation with the catgut the media must be boiled 5 to 10 minutes to drive off the oxygen, then cooled quickly, inoculated promptly with the catgut, and sealed at once to prevent the return of the oxygen. As already stated, Dubos has shown that this boiling of the media not only drives off the contained oxygen but produces a favorable reduction potential which may last for several hours even after the return of atmospheric oxygen; and if there are enough reducing substances in the media, a little prolongation of the time between cooling and sealing may not alter greatly the favorable condition of the media. It

TABLE VI.—A COMPARISON OF DIFFERENT HYDROGEN-ION CONCENTRATIONS IN THE GELATIN MEDIA, SHOWING GROWTH OF THE COMMON GAS-GANGRENE ORGANISMS AND TETANUS FROM TRANSPLANTS OF DILUTED CULTURES

Cult. dil.	Bacillus welchii					Vibrion septique				
	pH. 7.0	7.2	7.4	7.6	8.3	7.0	7.2	7.4	7.6	8.3
1	+	+	+	+	+	+	+	+	+	+
2	+	+	+	+	+	+	+	+	+	+
3	+	+	+	+	+	+	+	+	+	+
4	+	+	+	+	+	+	+	+	+	−
5	−	+	+	+	−	+	+	−	−	−
6	−	−	−	−	−	−	−	−	−	−
7	−	−	−	−	−	−	−	−	−	−
8	−	−	−	−	−	−	−	−	−	−

Cult. dil.	Bacillus œdematiens					Bacillus sordellii				
	pH. 7.0	7.2	7.4	7.6	8.3	7.0	7.2	7.4	7.6	8.3
1	+	+	+	+	+	+	+	+	+	+
2	+	+	+	+	+	+	+	+	+	+
3	+	+	+	+	+	+	+	+	+	+
4	−	+	+	+	−	+	+	+	+	+
5	−	−	+	−	−	+	+	+	+	−
6	−	−	−	−	−	+	+	+	+	−
7	−	−	−	−	−	−	−	−	−	−
8	−	−	−	−	−	−	−	−	−	−

Cult. dil.	Bacillus tetani					Bacillus histolyticus				
	pH. 7.0	7.2	7.4	7.6	8.3	7.0	7.2	7.4	7.6	8.3
1	+	+	+	+	+	+	+	+	+	+
2	+	+	+	+	+	+	+	+	+	+
3	+	+	+	+	+	+	+	+	+	+
4	+	+	+	+	+	+	+	+	+	+
5	+	+	+	+	+	+	+	+	+	+
6	−	+	+	+	−	+	+	+	+	+
7	−	−	−	−	−	−	−	−	−	−
8	−	−	−	−	−	−	−	−	−	−

TABLE VII.—SHOWING THE DURATION OF INCUBATION WHICH WAS REQUIRED BEFORE GROWTH APPEARED IN THE TWENTY-TWO CONTAMINATED SPECIMENS OF "STERILIZED" CATGUT

Days of incubation	Number of specimens
1	0
2	2
3	1
4	1
5	0
6	4
7	5
8	1
9	0
10	0
11	0
12	2
13	6

is obvious, however, that whatever oxygen enters during that time must be reduced before bacteria will grow and it is therefore advisable to minimize the re-entry of the oxygen as much as possible. If a decolorized methylene blue indicator tube is left open to atmospheric air, the color gradually returns so that in 15 to 30 minutes it is all blue. This return is slower if there are reducing substances in the indicator tube. If a large number of specimens are to be tested it would seem advisable to cool down for the inoculation only those tubes which could be sealed again within 15 minutes.

DURATION OF INCUBATION

Organisms in the innermost parts of twisted catgut may have difficulty in growing until the catgut has been softened and the medium has penetrated into its center. One would expect, therefore, that the heavier strands of catgut would need a longer period of incubation than the thinner strands. This is doubtless true; but, another factor is of importance with regard to the duration of incubation. Even with a fresh culture, when individual organisms are transplanted to a fresh culture medium some begin to grow in 24 hours, others in 48 hours, and still others only after a number of days' incubation (Burke, 5). It may take several days for small numbers of organisms present in catgut to adapt themselves to the new environment or for the medium to reach a favorable reduction potential satisfactory for their proliferation. For that reason it is important to maintain incubation for as much time as any living organism may require to demonstrate its presence.

When we tested raw catgut we found that the organisms developed within 2 or 3 days of incubation. There the presence of non-sporeforming, easily growing organisms may have hastened the development of those more fastidious. On the other hand it is certain that organisms appeared in some of the cultures after prolonged incubation which did not appear with the first sub-cultures.

When we came to examine specimens of catgut purchased from the open market or sent to us by surgeons scattered over the country, the results were quite different. These specimens, without a doubt, had been put through certain processes with the intention of sterilizing them and yet 22 out of 174, or 12½ per cent, yielded positive cultures. In these tests, growth did not take place as rapidly as with the raw catgut, probably because the organisms were few in number and the more easily growing non-sporeformers had been killed off. The first evidence of growth appeared in some instances as late as the thirteenth day as Table VIII shows. Another reason for the late appearance of growth may be that these specimens came from batches of catgut which had been tested and liberated for sale after considerably briefer incubation of representative tubes. The large number of cultures in which growth did not appear until the twelfth or thirteenth day indicates that this should be the minimum duration of incubation for catgut and that the incubation for 5 to 7 days, as practiced by most of the firms at present, is not adequate. It further indicates that the thickest strands of catgut from every batch should be selected for the test. In order to have a margin of safety we feel that 15 days' incubation should pass without growth before a batch of catgut may be safely liberated. We realize that this will mean a larger storage space for sterilized catgut awaiting the result of the test but we believe that the price of safety that this represents will not be too great for the honest catgut firms to be willing to pay.

THE NEUTRALIZATION OF CHEMICAL SUSPENDING FLUIDS

Most of the catgut which is sealed in tubes is suspended in some fluid. Most of these fluids are to some degree bactericidal or bacteriostatic. These fluids have been permitted to penetrate into the innermost parts of the catgut and when it is removed from the tubes a certain amount of the fluid is carried over on the surface and in the substance of the catgut. These chemicals will often inhibit the growth of bacteria, even when present in very high dilution and will often be bacteriostatic when they are not bactericidal.

Certain of the catgut firms have not taken this into account, but have depended upon a large quantity of media to dilute the chemical to a point where there shall be no interference. Others have attempted to wash out the chemicals with sterile water. It has been demonstrated, however, that the catgut and the contained bacteria may fix the chemical without having the bacteria destroyed by it. Thus simple washing is ineffective.

Geppert was the first to advise the use of neutralizers. The British workers (4) have made a great point of the necessity of chemically neutralizing these chemicals and quote the experience of others and their own experiments to substantiate this. The chief substances which are now in use are iodine and mercury. The British workers have advocated the use of ammonium sulphide or sodium thiosulphate with sodium carbonate to neutralize these antiseptics. When these solutions are added to the fluids or to catgut containing them, insoluble precipitates are formed, or other chemical changes take place which render the substance inert.

We have confirmed this finding and have demonstrated that it is necessary to add these neutralizers in order to permit the growth of the stricter anaerobes when inoculated in high dilution. We demonstrated this first by simply adding cultures in increasing dilutions both with and without the neutralizers. In every instance higher dilutions of inocula grew out in the tubes containing the neutralizing fluid than in the others. Likewise, when strands of catgut were removed from the sealed tubes and planted in the medium and subsequently increasing dilutions of culture were planted, growth took place invariably with higher dilutions of the culture, if neutralizers were added to the medium (Table VIII). This demonstrated that enough of the chemical fluid was carried over to inhibit growth in the test tubes, unless they were neutralized. Table VIII shows further that simply washing the catgut in water for 24 hours, as advocated by some firms, is not sufficient to prevent the bacteriostatic action of the chemicals; nor can a large quantity of media dilute the chemicals sufficiently to prevent the bacteriostatic action.

TABLE VIII.—A COMPARISON OF CULTURES IN THE PRESENCE OF CATGUT (a) TAKEN DIRECTLY FROM THE SUSPENDING FLUID, (b) AFTER WASHING IN WATER, (c) AFTER NEUTRALIZING THE SUSPENDING FLUID

Cult. dil.	Suspending fluid not washed off		Suspending fluid washed with water 24 hrs.		Suspending fluid neutralized	
	Infusion	Extract	Infusion	Extract	Infusion	Extract
1	−	−	−	−	+	+
2	−	−	−	−	+	+
3	−	−	−	−	+	+
4	−	−	−	−	+	+
5	−	−	−	−	+	+
6	−	−	−	−	+	+
7	−	−	−	−	−	−

Gelatin glucose media were made from both beef extract and beef infusion. Increasing dilutions of bacillus œdematiens culture were added to the media after the catgut had been transferred.

THE NUMBER OF SPECIMENS TO BE EXAMINED

A certain proportion of each sterilized batch must be examined. We believe that 2 specimens for every batch of 500 or less and 2 for each additional 500 is an adequate number. Of each pair of test specimens one is to be tested under aerobic and the other under anaerobic conditions. If a batch of catgut contains strands of various sizes the largest sizes should be taken for the tests.

Actual Procedure

1. Optional (O). Two operators wearing caps and masks work together and make transfers in a dust proof chamber.

2. (O). The outside of the tubes must be sterilized in one way or another. If there is no filed line in the center it should be made. The ends of the tube are taken in the fingers and the central half flamed in a wing flame. A momentary contact is sufficient, the contents should not be heated. The tube may then be broken at the filed line without risk of comtaminating the contents. As this is designed to prevent falsely positive growth, a chemical method of sterilizing the tubes may be substituted. If envelope containers are used one margin should be flamed.

3. Essential (E). The loop or strand of catgut is seized with a pair of long forceps of the "alligator" or some other convenient type, previously flamed. Before flaming they may be dipped in alcohol to save time and insure complete flaming. The catgut is removed from the tube or envelope and transferred to a test tube containing 40 cubic centimeters of sterile distilled water. The cotton plug is removed from the test tube and the mouth flamed as the transfer is made.

4. (E). The tube is then incubated for 24 hours.

5. (E). The catgut is then transferred to a test tube containing the 1 per cent sodium thiosulphate and 1 per cent sodium carbonate and again

incubated for 24 hours. (If antiseptics other than iodine or mercury are used the appropriate neutralization must be accomplished at this point in the same way.)

6. (E). The culture media is boiled in a water bath for 10 minutes or more.

7. (E). The vaseline or "vaspar" sealing material is melted in a water bath.

8. (E). The catgut is then transferred to the media and the tubes to be incubated anaerobically are sealed by pouring on a layer 2 centimeters thick. The sealed tubes may then be cooled to solidify the seal. The time between the removal of the media from the boiling water and the pouring of the seal should not exceed 15 minutes.

9. (E). The tubes are incubated for 15 days and then examined for growth. More frequent examinations are optional. Only the batches yielding no growth in all representative tubes may be released for sale. If any show growth the test must be repeated, with twice the number of representative tubes from the same batch. If any tubes show growth in the repeated test the whole batch must be resterilized or destroyed.

10. (E). The media should be controlled for sterility by using from 2 to 5 per cent uninoculated tubes and incubating them for the full length of the test. Likewise the growth-producing properties of the medium must be controlled by a series of six tubes planted with decimal dilutions of an active culture of bacillus œdematiens, or (if a pathogenic species cannot be used) bacillus sporogenes. If growth does not appear down to the fifth dilution, which would be 1:100,000 of a cubic centimeter of the original culture, the media must be considered to be inferior in some respect.

11. (E). The test organism should also be transplanted into tubes which have remained negative throughout the duration of the test, in order to demonstrate that chemical substances have not been carried over in sufficient concentration to inhibit growth. This should be an occasional test only.

It is believed that if this test is rigorously carried out by all catgut firms, the chances of purchasing unsterile catgut on the market will be reduced to a minimum. If any catgut firm finds that the tests repeatedly show growth, it should change its method of sterilization until the test is consistently negative. In order to make this safeguard continuously operative, it will be important for the Hospital Standardization Committee to set up some mechanism for its maintenance. This will require the periodic inspection of the methods for testing sterility employed by the catgut firms and the periodic testing of specimens purchased on the open market over a period of years.

Chemically, one would expect that the ammonium sulphide would give a more efficient neutralization of the antiseptic than sodium thiosulphate, since the precipitate formed by the thiosulphate goes into solution again with an excess of thiosulphate. However, the bacteriostatic action is neutralized, for growth takes place after the inoculation with the same dilution of culture as it does when ammonium sulphide is used (Table IX). The thiosulphate is, therefore, a little better for the test because of the absence of the black precipitate which, if carried over into the final culture tube, may interfere with the gross reading of the culture. With iodine the thiosulphate is the neutralizer of choice. If mercury but no iodine has been used as an antiseptic, ammonium sulphide may be used instead of sodium thiosulphate. If neither iodine nor mercury have been used, but some other chemical substance, there must be a step in the test for sterility in which this chemical substance has been rendered chemically inert.

THE PROPOSED STANDARD TEST FOR STERILITY

It was not necessary for us to experiment with every possible variation in the steps of our procedure. We have taken for granted certain fundamental rules which are outlined in any textbook of bacteriology. What we have tried to do has been to favor in every possible way the detection of the sporeforming organisms, which are the ones to be feared from improperly sterilized catgut. But until we find a medium in which "100 per cent takes" are obtained when individual spores are transplanted we will not feel that we have attained the ultimate goal. This may be impossible, for all spores may not be viable. At any rate, the method that is here proposed is superior to any that we have been able to find in available sources of anaerobic bacteriology of the present day, and until this method is improved upon, we believe that it should be adopted as standard. Certain of the steps in the procedure are considered to be *essential* (E), some are *optional* (O). The essential ones are those which we think are necessary for the detection of organisms, even when present in very small numbers. These are designed to prevent *falsely negative* results. The optional ones are designed to prevent contaminations of the culture from outside sources. These might be called *falsely positive* results. It is of course important, from a practical point of view, for the catgut firms to minimize *falsely positive* results; and they may be expected to go as far in

this direction as they feel they can afford. We see no reason for forcing these steps upon them and therefore call them optional. We will indicate with the capitals E and O, the steps which we consider essential or optional.

Materials

Media. The media must be based upon the usual bacteriological nutrient broth with 1 per cent peptone and ½ per cent sodium chloride. Whether it is made from beef or veal and by infusion or extract or from dried products which are put out by certain of the media firms, is not essential. If meat infusion is used there should be a half kilogram of meat for a liter of medium. If meat extract is used there should be 5 grams to a liter. It is important, of course, to know the quality of the peptone and this should be checked frequently, because peptone from the same source may vary from time to time. Of great importance, however, are the other ingredients, namely 2 per cent gelatin, 1 per cent glucose, and 1 per cent litmus. The gelatin must be of a high grade.[1] The glucose must be chemically pure. Only the media used for the anaerobic cultures need contain the litmus. Nutrient broth is made up in the usual way, and then the gelatin and glucose are added and mixed by heating. The media must then be alkalinized with sodium hydroxide so that after sterilization (see below) it will yield a final hydrogen-ion concentration of 7.2–7.4. A preliminary hydrogen-ion concentration of 7.6 is usually correct. One per cent litmus is then added to half of the media. It is filtered and then the media is distributed in test tubes of convenient dimensions in 40 cubic centimeter quantities. The plugs should be of non-absorbent cotton with gauze wrapping. The sterilized tubes may be kept at room temperature for not more than 2 weeks or in the ice-box not more than 4 weeks. Older media will show deterioration and will be less favorable for growth and should not be used.

Washing fluids. A similar number of tubes of the same size, containing 40 cubic centimeters of distilled water should be made up, and a similar number containing 1 per cent sodium thiosulphate and 1 per cent sodium carbonate in distilled water. These are to be used for the preliminary neutralization of the "antiseptic" suspending fluids.

Anaerobic seal. For the anaerobic seal, vaseline with a melting point around 48 degrees C. or equal parts of vaseline and paraffin with a melting point around 53 degrees C., are put up in test tubes, in quantities of 50 to 100 cubic centimeters. Larger quantities may resist sterilization in the center of the mass but may be used up to 500 cubic centimeters if autoclaved for 1½ hours.

[1] We recommend the Gold Medal Gelatin of Coignet Père et Fils Cie. or the granulated gelatin of the Digestive Ferments Co., Detroit, Mich.

TABLE IX.—A COMPARISON OF AMMONIUM SULPHIDE WITH SODIUM THIOSULPHATE AND SODIUM CARBONATE AS NEUTRALIZERS FOR THE CHEMICAL SUSPENDING FLUIDS

Cult. dil.	Vibrion septique				Bacillus œdematiens			
	Suspending fluid not washed off	Neut. with 1% ammon. sulphide	Neut. with 1% sod. thio. and sod. carb.	Gelatin control. No catgut	Suspending fluid not washed off	Neut. with 1% ammon. sulphide	Neut. with 1% sod. thio. and sod. carb.	Gelatin control. No catgut
1	−	+	+	+	−	+	+	+
2	−	+	+	+	−	+	+	+
3	−	+	+	+	−	+	+	+
4	−	+	+	+	−	+	+	+
5	−	−	+	+	−	−	−	−
6	−	−	−	+	−	−	−	−
7	−	−	−	−	−	−	−	−

Sterilization

When the media has been distributed to the tubes it should be sterilized either for 3 successive days, in the Arnold for one-half hour at 100 degrees C.; or once in the autoclave for one-half hour at 17 to 20 pounds pressure or 120 degrees C. temperature. A word of caution is needed for the use of autoclaves which do not have a thermometer. If they are properly operated the "temperature" indicated on the pressure gauge may be accurate, but if there is an error in the technique, particularly with regard to the removal of the contained air, the temperature often will not reach the degree indicated on the pressure gauge. It is recommended, therefore, that thermometers be used in all autoclaves, or that a self-recording high-low thermometer be placed in the autoclave with the media. If the Arnold method is used, the tubes should be incubated between daily sterilizations; but, inasmuch as many spores fail to grow out in 24 hours or even longer, falsely positive results may in the long run exceed those obtained with autoclaved media. The physical properties of the gelatin and glucose are not so likely to be changed with the Arnold as with the autoclave sterilization but when media sterilized by these two methods are compared they are found to be equally effective in promoting growth in high dilutions of inocula. After sterilization the tubes should be incubated for 3 days to bring out any gross contaminations, but the real control of the sterility of the media will have to depend upon the incubation of a number of uninoculated tubes,

incubated for the full length of the test, along with those containing the catgut. The distilled water as well as the sodium thiosulphate and sodium carbonate solutions, are sterilized by autoclaving for one-half hour at 17 to 20 pounds pressure, or 120 degrees C. The vaseline and paraffin mixture should be sterilized in the autoclave for one hour at 120 degrees C., or at 17 to 20 pounds pressure, or by dry heat at 165 degrees C.

SUMMARY

It has been demonstrated, both from the development of postoperative infections traced to catgut and by the examination of specimens of catgut obtained from the open market, that surgeons throughout the country are using contaminated catgut in their operations, from time to time. With the hope of making it impossible to purchase contaminated catgut, we have studied the problem and have proposed a test for catgut sterility.

The test is based upon the careful study of bacteria present in raw catgut particularly the pathogenic sporeforming anaerobic organisms. We have found that all of the common gas-gangrene organisms may be present in catgut, and others have demonstrated the occurrence of the bacillus of tetanus. We have studied the cultural characteristics of these organisms, as well as the pyogenic cocci. We have tested the methods used by various catgut firms and have reviewed the methods of anaerobic culture advocated by Hall, Bulloch, Kahn, and others, with particular respect to the nutrient elements and the oxidation reduction potential of the media, the degree of anaerobiosis, the nature of the anaerobic seal, the hydrogen-ion concentration, the neutralization of the "antiseptic" suspending fluids, and the necessary duration of incubation. The media should be a clear fluid containing adequate nutrient substances such as meat infusion broth with peptone and reducing substances such as glucose and gelatin. Its hydrogen-ion concentration should be the optimum for the pathogenic sporeforming anaerobes, which is pH 7.2 to 7.4. It should be sealed with an impervious seal such as vaseline or "vaspar" which should be overlaid within a few minutes after the transfer of the catgut. Before inoculation into the media the catgut should be washed as free as possible from the suspending fluids, which must be further neutralized with chemicals. The heaviest strands of catgut from each batch should be selected for the test. After inoculation, incubation should be carried on for a minimum of 15 days without evidence of growth before the batch is liberated for sale. This test may be used satisfactorily by catgut firms and by hospital laboratories.

We hope that the Hospital Standardization Committee of the American College of Surgeons will demand this test of all catgut firms, the products of which they recommend, that hospitals will purchase supplies only from those firms which conscientiously and continuously apply this test, and that the Army and Navy and U. S. Public Health Service will do the same. We believe that its constant employment will result in the elimination of unsterile catgut throughout the country. We trust that eventually the government will further strengthen this safeguard by legal action.

BIBLIOGRAPHY

1. Barber, M. A. The pipette method in the isolation of single micro-organisms and in the inoculation of substances into living cells. Philippine J. Sc., 1914, ix, 307–360.
2. Idem. Use of the single cell method in obtaining pure cultures of anaerobes. J. Exper. Med., 1920, xxxii, 295–311.
3. Idem. The effect on mice of minute doses of B. anthracis. J. Infect. Dis., 1909, vi, 634–661; The infection of guinea pigs, monkeys and rats with doses of plague bacilli ranging from one bacillus upwards. Philippine J. Sc., 1912, vii, 251–254.
4. Bulloch, W., Lampitt, L. H., and Bushill, J. H. The preparation of catgut for surgical use. Brit. Med. Research Council. Special Report Series 138, 1929.
5. Burke, V., Sprague, A., and Barnes, L. Dormancy in bacteria. J. Infect. Dis., 1925, xxxvi, 555–560.
6. Chambers, R. New micromanipulator and methods for the isolation of a single bacterium and the manipulation of living cells. J. Infect. Dis., 1922, xxxi, 334–343.
7. Clark, W. M., and collaborators. U. S. Public Health Rep., 1924, xxxviii, 443–455, 666–683, 933–958, 1669–1718; 1924, xxxix, 381–414, 804–823; 1925, xl, 649–663, 1131–1201.
8. Dubos, R. The initiation of growth of certain facultative anaerobes as related to oxidation-reduction processes in the medium. J. Exper. Med., 1929, xlix, 559–573.
9. Gates, F. L., and Olitsky, P. K. Factors influencing anaerobiosis with special reference to use of fresh tissue. J. Exper. Med., 1921, xxxiii, 51–68.
10. Geppert, J. Zur Lehre von den Antiseptics. Ein experimental Untersuchung. Berl. klin. Wchnschr., 1889, xxvi, 789–794, 819–821; 1890, xxvii, 246–249, 272–274, and 297–304.
11. Hall, I. C. A review of the development and application of physical and chemical principles in the cultivation of obligately anaerobic bacteria. J. Bacteriol., 1929, xvii, 255–301.
12. Idem. Chemical criteria of anaerobiosis. J. Bacteriol., 1921, vi, 1–42.
13. Henry, H. An investigation of the cultural reaction of certain anaerobes found in wounds. J. Path. & Bacteriol., 1917, xxi, 344–385.
14. Holman, W. L. The value of a cooked meat medium for routine and special bacteriology. J. Bacteriol., 1919, iv 149–155.

15. HUNZIKER, O. F. Review of existing methods for cultivating anaerobic bacteria. J. Applied Micr. & Lab. Meth., 1902, v, 1694–1697, 1741–1758, 1800–1813, 1854–1856.
16. KAHN, M. C. A cultural study of anaerobic spore-bearing bacteria with strains isolated by the Barber single cell technique. J. Med. Research, 1922, xliii, 155–206.
17. Idem. Personal communication.
18. KITASATO, S., and WEYL, F. Zur Kenntniss der Anaeroben. Ztschr. f. Hyg., 1890, viii, 41–47.
19. KNORR, M. Der Keimgehalt des sterilen Handelskatguts. Muenchen. med. Wchnschr., 1930, lxxvii, 581.
20. KUHN, F., and ROESSLER, M. Tetanus und Katgut. Deutsche klin.-therap. Wchnschr., 1906, xiii, 1153.
21. MACKIE, T. J. An inquiry into postoperative tetanus; a report to the Scottish Board of Health, p. 62. Edinburgh, 1928.
22. MCINTOSH, J., and FILDES, P. A new apparatus for the isolation and cultivation of anaerobic micro-organisms. Lancet, 1916, i, 768–770.
23. M'LEOD, J. W., and GORDON, J. The problem of intolerance of oxygen by anaerobic bacteria. J. Path. & Bacteriol., 1923, xxvi, 332–343.
24. M'LEOD, J. W. Bacterial Oxidations and Reductions. Chap. 14—The newer knowledge of bacteriology and immunology—by JORDAN, E. O., and FALK, I. S. Chicago: University of Chicago Press, 1928.
25. MELENEY, F. L., and CHATFIELD, M. How can we insure the sterility of catgut? Surg., Gynec. & Obst., 1930, l, 271–277.
26. MELENEY, F. L., HUMPHREYS, F. B., and CARP, L. An unusual fatal operative wound infection yielding a pathogenic anaerobe of the gas-gangrene group. Surg., Gynec. & Obst., 1927, xlv, 775–789.
27. NOVY, F. G. Die Kultur anaerober Bakterien. Centralbl. f. Bakteriol., Abt. 1, Orig. 14, 1893, 581–600.
28. ROUX, E. Sur la culture des microbes anaérobies. Ann. de l'Inst. Pasteur, 1887, i, 49–62.
29. WOLF, C. G. L., and HARRIS, J. E. G. Contributions to the biochemistry of pathogenic anaerobes. J. Path. & Bacteriol., 1917, xxi, 386–452.

INDICATIONS AND TECHNIQUE OF THE DIFFERENT OPERATIONS FOR CHRONIC MASTOIDITIS[1]

J. MORRISSET SMITH, M.D., NEW YORK

THE average temporal bone shows an extremely wide variation in its normal structural anatomy. The tympanic membrane and ossicular chain are normally present in every case and constant in their anatomical relations. The bone in the attic antrum and mastoid varies from the small infantile type, showing a far forward lateral sinus and dense sclerosis without cells or mastoid cavity to the very extensive pneumatic with large cells extending throughout the mastoid and petrous pyramid.

It was formerly thought that the sclerotic bone encountered in chronic mastoiditis was due to the infection. While this is true to a limited extent, a large number of cadaver dissections will show many sclerotic bones with an absence of cells and mastoid cavity where there has been no evidence of a previous mastoid infection.

The marked difference in the normal structure of the average temporal bone means a wide variation in the degree of bone destruction encountered in the different mastoids and makes it necessary to employ more than one type of operation for the relief of chronic mastoiditis.

The operative procedure employed should first remove the danger and then conserve as much of the normal tissues and hearing as possible. Generally speaking the preservation of part of the ossicular chain and tympanic membrane will mean the retention of hearing which will be of practical use to the patient, while the removal of the ossicles and drum, especially by the radical operation, will result in a material reduction of the hearing. In the management of chronic mastoiditis, unless there is an emergency operation indicated, the tonsils and adenoids should always be removed and any existing nasal obstruction or infection corrected as far as possible before the operation. The thorough removal of the tonsils and adenoids is especially important in young children suffering from chronic otorrhœa.

There are at least four mastoid operations which may be advantageously employed in chronic mastoiditis. They are: the complete simple mastoid operation, the new radical operation, the modified radical operation, and the complete radical operation. They all have their selective indications.

The complete simple mastoid operation. This is the most conservative and one of the most effective of the different operations advocated for the relief of chronic mastoiditis. It has not been accorded the recognition it deserves. It is primarily indicated where the drum and ossicles do not require removal. All accessible granulation tissue and polypi in the middle ear should be removed through the external auditory canal before operation. This is best accomplished with a small aural cutting forceps after the local use of a 10 per cent cocaine solution.

The technique. The usual mastoid incision and exposure of the cortex is made and the mastoid cells exenterated to healthy plate in the middle and posterior fossæ. The mastoid antrum is widely opened and the dissection of the bone at the root of the zygoma is carried forward until the short process of the incus is thoroughly exposed where it is attached just external to the horizontal semicircular canal. All the accessible granulation tissue in the posterior part of the additus is removed. The usual postoperative care of the simple mastoid wound is then carried out. The external canal is packed for 7 days and daily irrigations with boric acid solution followed by alcohol drops are used thereafter.

This operation properly performed eradicates all of the diseased bone in the mastoid, the antrum, and the posterior part of the additus leaving only a small amount of granulation tissue in the upper part of the middle ear. It will frequently result in a dry ear with the preservation of useful hearing and is especially indicated in young children. It will often avoid a radical operation; if not

[1]Presented before the Clinical Congress of the American College of Surgeons, Philadelphia, October 13-17, 1930.

successful one of the more radical procedures can always be performed.

The new radical operation. The writer's original article describing the technique of this operation was printed in the *Medical Journal and Record* for April 3, 1929. The contents of the middle ear, eustachian tube, attic, antrum, and mastoid are thoroughly exenterated as in the radical operation. This is accomplished without removing the posterior bony canal wall which separates the middle ear from the mastoid cavity thereby permitting the mastoid wound to fill in with healthy granulation tissue as in the simple mastoid operation. Epidermatization of the middle ear is then obtained so that the result is similar to an unoperated upon, healed chronic purulent otitis media.

The technique. The usual simple mastoid incision is made, starting over the center of the mastoid tip and following the normal curve of the external ear one-quarter to one-half inch behind its attachment. The incision extends upward just above the temporal ridge. The cortex is exposed with the spine of Henle, the temporal ridge, and mastoid tip in full view. The bone is removed just below the temporal ridge and behind the spine of Henle until the mastoid antrum is entered. The posterior canal wall is not lowered unless it be necessary to remove the outer part to avoid a far forward lateral sinus. All of the granulations and diseased bone are removed from the antrum and mastoid cavity as in the simple mastoid operation. In the average chronic case there are few if any mastoid cells present; however, the cavity is cleaned to healthy plate or bone regardless of the extent. The additus is now enlarged by removing a small portion of the inner part of the bridge just external to the incus and horizontal semicircular canal. If this opening is made too large, it may interfere with the granulations filling in the posterior wound. The remnants of the ossicles may be removed through the additus. In some instances it may be easier to remove the malleus through the external auditory canal. The posterior half of the membranous canal is then carefully separated from its bony attachment in the external auditory canal and held in place against the anterior canal wall, if possible allowing the anterior membranous attachment to remain intact. This allows access to the middle ear and attic. Through this opening the granulations and débris are removed from the middle ear. The annulus tympanicus is then removed and the eustachian tube thoroughly curetted. This leaves the attic and bony space extending posteriorly into the additus to be cared for. Free access may be had to this space in the roof of the middle ear by partially removing the external wall to the attic. This corresponds to the rim of bone furnishing the attachment for the upper part of the annulus tympanicus or the bony rim in each side of the Ravinin fissure. The removal of this bone together with the contents of the middle ear must be carefully performed since the floor of the cavity at the time of operation is represented by the internal wall of the middle ear. The facial nerve, crossing the inner wall through the fallopian canal is covered by a very thin layer of bone; pressure on its wall will result in facial paralysis. An accurate knowledge of the anatomy is necessary to avoid the removal of the stapes or injury to the labyrinth. Care must also be taken to leave a firm posterior bony canal wall; necrosis may result if too much of it is removed.

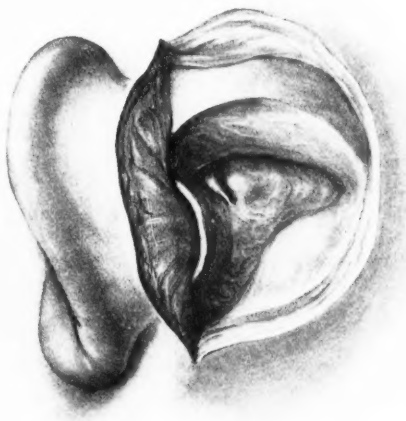


Fig. 1. Left ear, showing the position of the incus in the cavity following a complete simple mastoid operation for chronic mastoiditis.

The operation at this point is represented by a clean middle ear, attic, antrum, and mastoid cavity with the posterior canal wall in its normal position. The membranous canal is now restored as nearly as possible to its original position in the external auditory canal and packed in place with vaseline gauze. A cigarette drain is inserted directly into the mastoid antrum behind and the mastoid wound closed above and below with clips.

The postoperative care of mastoid is similar to that following the simple mastoid operation. The middle ear is kept free from granulation tissue and allowed to dermatize. It is not indicated in all cases of mastoiditis. Symptoms of an intracranial extension of the infection, extensive necrosis of the bone, small external auditory canal are instances in which the complete radical operation will be best. With the proper selective use it may be employed in fully three-fourths of the cases upon which a radical operation has been performed in the past.

The modified radical operation. This operation has been thoroughly written up several times. Its principle depends upon the eradication of the diseased tissues in the mastoid, antrum, part of the attic and the reduction of the posterior canal wall without removing the annulus tympanicus and ossicles. The membranous meatus is then enlarged by cutting a flap. It will undoubtedly result in the preservation of valuable hearing and avoid a radical operation in selected cases. I prefer to use the complete mastoid operation in its place.

The complete radical operation. An extensive destruction of bone, a suspected or definite evidence of an intracranial extension of the infection will require a complete radical operation. It makes possible the most extensive eradication of the diseased bone, converting the middle ear and mastoid into one large cavity and removing all the necrotic tissues in the tympanicum, eustachian tube, attic, antrum, and mastoid. A flap is then cut, the postauricular incision is closed, and the wound is dressed through the enlarged membranous meatus. It has a very definite indication in a certain percentage of chronic infections and cannot be replaced by any of the modifications. A detailed description of this operation was read by the writer at the annual meeting of the American Otological Society, May, 1930.

So far as the patient is concerned, there is only one way of estimating the hearing after a mastoid operation and that is from a practical standpoint. There should be sufficient hearing remaining after the operation to permit the individual to carry on the average daily routine. The problem is not a difficult one where there is normal hearing in the other ear; it becomes a very serious one when there is a bilateral operation indicated or when there is deafness in the opposite ear.

It has been the writer's experience that the postoperative hearing following the average radical mastoid operation has been of little practical value to the patient, and that one of the more conservative operations can be safely employed with better hearing results, in a large percentage of the cases.

The dense sclerotic bone encountered in the average chronic infection makes it very difficult in many instances to estimate the degree of destruction before operation and is often necessary for the operator to be guided by the pathology in the individual case.

SUMMARY

1. The complete simple mastoid operation provides for the eradication of all the diseased tissues in the mastoid without disturbing the conducting apparatus, namely, the ossicles and drum.

2. The modified radical operation obtains the same result except that the posterior bony canal wall is lowered and the membranous meatus is enlarged.

3. The new radical operation, while it allows the posterior bony canal wall to remain in its normal position, goes a step further and permits the removal of the contents of the middle ear, including the malleus incus and drum membrane.

4. The radical operation provides for the complete removal of the diseased structures in the middle ear and mastoid including the posterior bony canal wall, the drum, and ossicles down to the internal wall of the middle ear and dural plate covering the brain in the middle and posterior fossæ.

5. The combined technique of the four offers a selective operation suitable for the management of all the different degrees of necrosis in chronic mastoiditis exclusive of the intracranial complications.

DISCUSSION

J. C. KEELER, M.D., F.A.C.S., PHILADELPHIA: I would like to ask whether Dr. Smith's dissections were made on the cadaver or on dried bone. Also whether he made histological studies of the antrum, tympanum, and mastoid cells.

Though I am fully aware that there is much variation in the histological structure of the mastoid bone as observed in different individuals, it is my opinion that when we find sclerosis of the bone it is always due to some previous, although very likely unrecognized, infection. It is a very difficult matter to rule out such previous infections. Frequently a patient will resent being told he has a discharging ear, even when pus is visible in the auditory canal. "How can there be an abscess without pain?" he demands. It is, therefore, still more likely that he will deny ever having had an infection which is now quiescent.

Though the removal of pathological conditions in sinuses, tonsils, and adenoids as preliminaries to the cure of a discharging ear is perfectly sound surgical technique, I am nevertheless convinced that there is altogether too much of this done when the ear condition demands radical surgery. The patient is assured that attention to nose and throat will dry up the discharging ear, which, in the presence of bone necrosis and cholesteatoma, is an absolute absurdity. Every year I see hundreds of patients who have been in the hands of surgeons of this type. Some of them will have undergone a half dozen so-called "operations," not one of which even approached the actual seat of the ear trouble. There are altogether too many men trying to do ear work who are either too ignorant or too timid to undertake the only possible means of clearing up the conditions with which they are presented.

The "complete simple mastoid operation" as described by Dr. Smith, is my conception of a complete mastoidectomy performed in a chronic process for drainage of the mastoid antrum and additus. It should precede the more radical procedure, especially when the patient is a child. The "new radical operation" as described by the essayist, is a most difficult procedure, but should be successful in a certain number of cases, provided there is not too extensive disease encountered. Though the ossicles are removed and the Eustachian tube curetted, a portion of the posterior osseous wall is left. This appears to me to be nothing more than foreign material, making a barrier for the retention of dèbris, and serving to hide from view the cholesteatoma which has been left behind. I, therefore, cannot see any advantages offered by this "new" operation over the procedures with which we are already familiar.

When Professor Robert Barany was in America during the winter of 1920–21 he performed a number of operations using a method which was a modification of a radical mastoidectomy, consisting of removal of the posterior osseous wall through the annulus tympanicus without disturbing the posterior cartilaginous canal. About 8 months later it became *my* duty to complete this operation. There is at present in this hospital, a child upon whom the identical procedure has been carried out, and judging by the scars, there have been at least two previous interventions. All this is evidence that many of the operations which are being done, are inefficient, and in many instances, absolutely unnecessary. Conservatism is praiseworthy when we have something worth saving, but in the presence of advanced bone disease, incomplete operation is far worse than nothing at all.

We are all familiar with the Heath or modified radical operation, and its limitations are very generally recognized. When intracranial complications are imminent, or other indications warrant its employment, the radical mastoid according to the accepted technique should be carried out with the greatest thoroughness, eradicating all diseased areas wherever found. And this will not be successful if the postoperative treatment is placed in inexperienced or careless hands.

Yet the radical mastoid operation is often life-saving, and should be performed *before* complications arise, rather than afterward. When I have had occasion to review the intracranial complications of otitic origin which I have seen during the past 10 years, and contemplate the frightful mortality due entirely to procrastination, which prompt surgical intervention would have obviated, I realize that we are still far from our goal of competent and satisfactory operative methods. Still I feel that what we need is more competent application of the methods we already have, rather than attempts to devise new ones.

In a series of 70 cases of intracranial complications of otitic origin I find that there were 29 of meningitis, 17 of brain abscess, 13 of sinus thrombosis, and 11 of extradural abscess. Only 24 of these patients recovered, the 46 deaths giving a mortality rate of 60.5 per cent. Practically every one of these patients could have been saved had sufficiently drastic surgical measures been applied *before it was too late.*

Taking up one or two points touched upon by the essayist: It has not been my experience that the cells are absent in the average chronic case of mastoid infection. In the majority of my patients I find diseased cells throughout the entire mastoid. In determining the extent of the disease process I have found the X-ray of the greatest value, and this also helps in the decision as to the type of operation required in the individual cases. It has not been my experience that the loss of hearing following the radical procedures is as great as many writers would lead us to believe.

PREPARATION FOR OPHTHALMIC PRACTICE[1]

EDWARD JACKSON, M.D., F.A.C.S., DENVER, COLORADO

OPHTHALMIC practice is a branch of medical practice—the study, relief, and prevention of disease—the maintenance of health. In the last hundred years, medicine has undergone an enormous development, for which its progress through historic time was a preparation. This development, in its scientific basis, its purposes, its study of methods of procedure, its accumulation of resources, its acceptance of responsibility, its new standards of exactness and skill, has compelled differentiation into special branches; each of which demands a lifetime of devotion to special work. One who would give adequate service in ophthalmic practice must be prepared to undertake and continue study, as minute as microscopic detail and as broad as modern science.

How can we furnish to the student the opportunity for study and development that will best fit him for the service he would render? All know ophthalmology has expanded in the last one hundred years; but do we realize how much it has expanded? An examination of a book printed this year shows that more than two-thirds of its contents refer to what has been learned within the last half century. This book is intended for general undergraduate students of medicine, and not for those specially preparing for ophthalmic practice. A similar examination of *Diseases of the Eye*, by de Schweinitz—the ophthalmologist's book of ophthalmology—shows that 92 per cent of ophthalmology, as there presented, has come into human knowledge within the last century. This is what the specialist in ophthalmology is supposed to know and offer for the benefit of his patients.

This expansion of subject matter, to be studied and mastered, is not peculiar to ophthalmology. It has occurred in every branch of medicine. It is still going on with increasing rapidity. De Schweinitz's book was first published in 1892. As compared with the first edition, his tenth edition, published 32 years later, shows an increase in matter of 74 per cent. For such a rate of progress the education of a specialist in medicine must provide. Examination of the biographies of eminent American ophthalmologists showed that almost without exception they had departed from the tradition; that a 5 or 10 years' experience of general medical practice was the proper way to prepare for special practice.

The recent realization of the amount of study required to fit one for practice of one branch of medicine implies such study, must begin early in life and be pursued zealously, with the advantages of the best opportunities and methods that can be devised. The *Directory* of the American Medical Association shows, that in the United States there are 5,090 physicians, engaged largely or wholly in ophthalmic practice. In small towns are some who never claim to specialize, but upon whom their communities depend for the best ophthalmic service. Remembering that the average age before getting into special practice is over thirty; and that some die, or go into other lines of activity, before reaching an age for retirement; an estimate of 25 years for an active professional life seems adequate, or liberal. This means that every year there should be prepared over 200 young ophthalmologists to take the places of those who are dropping out of the service. This number makes no provision for the rapid growth and development of the specialty; in the direction of more eye examinations for school children, public services, and industrial occupations; and the general applications of ophthalmology in diagnosis of cases seen in other branches of medical and surgical practice.

At the International Congress of Ophthalmology, held last year in Holland, Dr. Walter R. Parker, chairman of the committee, reporting on a program of ophthalmology for future ophthalmologists, stated that replies to a questionnaire, sent to the medical colleges of the United States, showed but 7 of them that offer systematic postgraduate work in ophthalmology. These are the Universities of

[1]Presented before the Clinical Congress of The American College of Surgeons, Philadelphia, October 13-17, 1930.

Colorado, Iowa, Johns Hopkins, Harvard, Michigan, Minnesota, and Pennsylvania. The largest number, 16, was provided for by the University of Pennsylvania; and the sum for all of these institutions is 55. It is probable that, adding the annual list of internes in special eye hospitals, and others incidentally trained for ophthalmology in the clinics of other medical colleges, not more than 100 fairly competent ophthalmologists are trained in this country each year—less than one-half of the number needed to keep up the present imperfect service in ophthalmic practice; with no provision to replace the still more faulty service offered by dealers in spectacles.

In 1914 a program of graduate training in ophthalmology was recommended by a committee of the Section on Ophthalmology of the American Medical Association; to be put into operation in all properly equipped medical colleges. So far it has not been made operative in 70 of these 77 institutions. It was admitted, then, that adequate training for ophthalmic practice was impossible by undergraduate study; and in the pamphlet on "Medical Progress" at the University of Pennsylvania, issued in connection with the celebration last week, occurs this statement: "The present condition of the medical curriculum makes unwise the addition of any further courses, such as one in medical physics."

Optics, a branch of medical physics, was made obligatory in the course leading to a graduate degree in ophthalmology at the University of Colorado, 17 years ago. In the last 3 years courses on physiologic optics have been given in 8 American cities to classes privately organized, ranging from 10 to 36 members each. In July of this year the eighth annual, two weeks' course, on ophthalmology and oto-laryngology, brought together in Denver 55 practitioners in those special branches, drawn from 19 states. Two weeks ago Miss Ida C. Mann, Fellow of the Royal College of Surgeons, and surgeon to the Royal London Ophthalmic Hospital, gave to a class of 25 in Denver, the course of lectures on "The Development of the Eye," that she has given in the graduate course leading to the Diploma in Ophthalmology at the University of Oxford; and this week she is giving this course to a larger class in Chicago. The travel courses to Europe have grown from year to year until this summer the International Assembly for Graduate Study gave its classes opportunities in each of a dozen cities, for study in a dozen different branches of medicine. Chevalier Jackson, of Philadelphia, is now in Paris, giving a course on bronchoscopy. The courses of lectures on the pathology of the eye given by Professor Fuchs, in this country 8 years ago, awakened a wide interest in his subject among ophthalmologists. Will not the universities of America take notice of this desire and demand for graduate instruction?

In our day and civilization, the education for a profession must be both theoretical and practical, both academic and clinical, must be kept up along different lines, and by various methods. But, in providing a larger and more comprehensive plan of building, *we must not forget foundations*. These, too, may need to be somewhat different. For ophthalmology we find some preparation is needed, that might be expected of premedical studies. Mathematics and physical optics are of more importance than acquaintance with modern languages, convenient tool as that may be. As matters now stand we cannot expect mathematical optics to be taken by all who may apply for entrance in medical schools; and can only require it for those who are taking up the study of ophthalmology as their special branch of practice. However, foundations will always remain foundations, and must be considered in all planning of new structures.

The most fundamental preparation for ophthalmic practice is the general medical education. This is sometimes forgotten. Ignorance of its importance may be expected of those who have never had a medical education, and know nothing of the scope and interdependence of medical science. Optometrists, manufacturing opticians, laboratory technicians, and electrical, or X-ray experts, may be useful; when their activities are directed by an intelligent comprehension of the whole domain of medical science. But to leave asepsis to the trained nurse, the evaluation of pathological appearances to the laboratory technologist, the study of visual fields to the student of psychology, or the measurement of refraction

to the optometrist-optician, is to introduce chaos in knowledge, and quackery in practice. The proposition to have an important part of ophthalmic practice taken up by persons destitute of medical training, as the refraction of the eye by doctors of optometry, has been urged; by those who have not considered the essential unity of health and all professional assistance that can be given toward it.

The unity of the living organism is the basis of health, and unity of all its branches is the basis of the medical profession, no matter how they may diverge in their development. The foundation must be laid in a common basic education, possessed by everyone who enters the profession. What this fundamental education must include may be discussed by that interested and intelligent part of our profession, engaged in practical teaching in our medical colleges. It cannot include all that should be known by one who goes before the community as prepared to practice some special branch of medicine. This is admitted; and the faculties of medical schools are doing good work in determining how much of such fundamental education they can give.

The year of training as interne in a general hospital, or its equivalent, is held essential to general medical education, required in some institutions before granting the medical degree, and in some states before conferring the right to practice. This interne year is a weak point in our system of medical education, which should receive attention from the American College of Surgeons, similar to that which has been given to some other points in the standardization of hospitals. To make the interne year what it should be, to give what the students and the public expect of it, every hospital physician and surgeon should be made to understand that the teaching of internes is a part of his hospital duty. In placing a physician on a hospital staff his fitness for teaching should be considered. Every interne should receive from the hospital, in the year he gives his services to it, the educational equivalent of those years he was formerly expected to gain in general practice, before devoting himself to a specialty.

Modern medical service demands teamwork. The basis of teamwork is mutual understanding and mutual confidence. The common understanding is obtained during the undergraduate years, by studying the same things together. The teamwork of the hospital, if properly developed and emphasized, trains for the broader work of the profession. Such training should be thorough in every respect. This year the internes serving in the eye departments of the various hospitals in Chicago, are being brought together for instruction in practical ophthalmology. This is a new form of teamwork. The contacts of those coming from various institutions, the enthusiasm developed where 20 or 30 young graduates in medicine join for such a purpose, must increase the value of the year's training. There are other ways of using mass enthusiasm and a common interest, to advance the skill of the young ophthalmologist, not only in his special branch, but in every branch of medicine. They are all needed.

When the young graduate is prepared, by his knowledge and training, truly to enter the medical profession, his need of education for some particular branch of medical practice must be recognized and provided for. In ophthalmic practice the greatest need is still *fundamental training*. It is 75 years since Helmholtz was writing his book on physiologic optics, that placed him in the highest rank among scientists. But it is only within the last 6 years, 65 years after its publication, that a translation of his work has been published in English. It was only within 3 years that an American opthalmologist ventured to publish a work on *Ophthalmic Optics*. When a graduate degree in ophthalmology was offered in this country, the first applicant for the course hunted up a high school teacher of mathematics, who would teach him plane trigonometry. He already had some knowledge of optics obtained in a high school course in physics. How many of the "ophthalmic surgeons" of America have this much acquaintance with optics?

The eye is the optical instrument of the body. To help it, all other optical instruments, from spectacles to reflecting telescopes, are made. How long will fundamental ignorance with regard to optics be tolerated in teachers and students of ophthalmology?

When Dr. Hay, of Boston, tried to study the action of combined cylindrical lenses, he sought assistance from Dr. Oliver, a teacher of mathematics at Harvard. John Green, at the age of over 50 years, and after teaching ophthalmology for 20 years, to understand the refraction of oblique rays by a spectacle lens, with the help of Professor Engler, of St. Louis, studied 4 or 5 years, algebra, trigonometry, and calculus, and reached a fine mastery of mathematic optics. Are we teachers of ophthalmology as well prepared today to understand the optical problems of the eye, and the glasses we are prescribing?

We have, as medical students, studied something of the anatomy of the eye. How much did that study prepare us for ophthalmic practice? After they had to teach in the course leading to a diploma in ophthalmology at Oxford University; Arthur Thomson, professor of anatomy, prepared and published his stereoscopic plates showing the anatomy of the eye; S. E. Whitnall, then Thomson's assistant, did the same for the anatomy of the orbit. G. J. Burch, teaching in the physiologic laboratory, wrote his *Physiologic Optics*, based on experiments. Whether he has studied anatomy in the book of Gray, Leidy, or Piersol, Deaver, Cunningham or Sabotta, the student today, preparing for ophthalmic practice, must study it in a way it has never been taught to undergraduate students of medicine. Some things about the eye are told in all books on physiology, and in lectures given to every student of medicine. But the knowledge of visual physiology possessed by the mass of recent medical graduates, is utterly inadequate for one who undertakes ophthalmic practice.

The gap between laboratory pathology and clinical medicine and surgery, is one of the greatest defects in medicine and surgery of today. This gap has, in a way, been bridged by the co-operation of the Army Medical Museum and the Committee of Ophthalmo-Pathologists appointed by the American Academy of Ophthalmology and Oto-Laryngology, the American Ophthalmological Society, and the Section on Ophthalmology of the American Medical Association. But only a minority of those in ophthalmic practice have taken advantage of this co-operation, and many of these have not had sufficient education in the pathology of the eye fully to profit by it. The recent graduate in medicine now comes with a very fair knowledge of general pathology; so that he could profit by good teaching on ophthalmo-pathology. But where can he get it? Pathology is one of the fundamental branches; that must be studied from a new point of view, by every graduate in medicine, who would qualify for ophthalmic practice.

The clinical examination of the eye by special methods and instruments is fundamental to ophthalmic practice. Oblique illumination, the ophthalmoscope, test-types, the Maddox rod, the trial lenses, the tonometer, the biomicroscope, have been mentioned and, perhaps, shown to every medical student; as they should be. But this does not constitute training for opthalmic practice. The embryology of the eye is a key to all its congenital anomalies and to the relations between the nutrition and pathological conditions of the different parts. It has been mentioned in general textbooks on anatomy and physiology, but its importance has only been brought home to us by the *Atlas Textbook* of Miss Ida C. Mann, and the lectures she is now giving.

Ophthalmology is a great branch of medicine, of rapidly extending and increasing importance. How shall it be taught to the thousands already engaged in ophthalmic practice, and to the hundreds that must take it up each year? Education for practice, preparation to take an honorable place in a profession, should be a subject for wide discussion and experiment. In general this study must go hand in hand with practice; and be kept up and kept fruitful, for men living in comparative isolation. New methods must be developed for such study and tested by experiment.

What demands immediate attention is the more general, effective study of the fundamentals, optics, anatomy, physiology, embryology, pathology, relations to other branches of medicine, and methods of diagnosis. These are needed as preliminaries to recognition of fitness to engage in ophthalmic practice. They are equally needed by many who have devoted years to ophthalmic practice. The emphasis

that has been placed on the "practical" aspects of ophthalmology, case taking, clinical diagnosis, prescribing of glasses, operations and methods of treatment, has caused the fundamentals to be overlooked and neglected. Study of fundamentals will correct the overemphasis that has been placed on technique, and make ophthalmic practice more effective.

There is great need that every medical school should arrange, announce, and emphasize short, intensive courses on the anatomy of the eye, orbit, and visual tracts. Visual physiology is taught in those schools giving systematic graduate courses, but needs more emphasis and more extended teaching. Optics needs better recognition as a medical study, and the teaching of it by experimental exercises will make it more interesting and more practical. Embryology will connect and illuminate many scattered clinical observations. All these things *can* be studied outside of medical schools, but are *best* studied in their laboratories and classrooms. They should be given in *short, intensive courses, of not more than one month each,* which those who are already engaged in ophthalmic practice can attend each year. Some can study these subjects from books, but the majority need the personal guidance and influence of the teacher. Graduate degrees will not greatly increase the number who will attend such courses. The stimulus to such work is chiefly appreciation of responsibility to patients, with desire to meet that responsibility in the best possible manner.

There will always be large opportunity for the individual student who masters one branch of ophthalmic science or practice and gives time to teaching others. That kind of work will always command respect and recognition from professional colleagues whether it be a branch of pure science, like embryology, or the improvement of an operation, as for cataract, or restoration of the lids, or eye movements, or control of trachoma, or the recognition of eye symptoms of general disease. Ophthalmological societies are recognizing the value of this kind of teaching, and are providing for it on their programs.

The movement to secure better training for ophthalmic practice is not coming to us from educational institutions, or philanthropic individuals, or public demand crystallized in legal enactment. It is a spontaneous effort of our profession to render better service. The American College of Surgeons may well take part in the improvement of training for special practice, and, by so doing, will show a way for graduate study in all surgical specialties.

DISCUSSION

T. B. Holloway, M.D., Philadelphia: Dr. Jackson, when presenting a subject, invariably gives us something to discuss, and in this instance he has not been an exception. The problem is not what to discuss, but where to stop, for few subjects are more important. In addition to this, he usually serves as a useful whip for the welfare of ophthalmology, and the lash is generally long enough to reach the leaders.

He has rightly pointed out the progress in all branches of medicine during the last one hundred years, in fact ophthalmology, as we understand it today, did not exist prior to that time; and that in spite of Sir Thomas Young and those practitioners who treated diseases of the eye. It can be said, however, that if the ciliary muscle had been discovered at the time Young lived we would have had a theory of accommodation that would have weathered the years as many of Jonathan Hutchinson's clinical observations succeeded in doing.

It would take far too long to discuss the various points Dr. Jackson has stressed, and I am sure we agree in that there should be a constant production of men who should be thoroughly grounded in all of the fundamental branches pertaining to ophthalmology. I believe that these men should not have less than 6 years' college and medical education, preferably longer, and that this should be followed by at least one year's interneship in a general hospital with rotating service. With this as a preliminary training the individual should be prepared for the acquisition of the real training in the subject he has elected as his life's work. This to my mind, is best obtained in a year's course devoted to what all of us understand as fundamental ophthalmic training, such as is outlined in a number of courses in this country. This may be followed by a year or more in some ophthalmic hospital or under the guidance and direction of suitable teachers in the eye service of a general hospital. After his year of fundamental ophthalmic training, certain hours could be devoted to practice. Concerning this, however, in my opinion the young man cannot waste time to better advantage than sitting in an office for 4 hours, when 2 hours may be ample; those 2 hours a day constitute 12 hours a week that should be put to use for future preparation.

For real success in ophthalmology as well as other branches of medicine, certain factors are essential; these are good health, a willingness to work, good habits, lack of jealousy, as this pertains to the

greater success or more rapid advancement of a fellow practitioner, a willingness to help others, and finally, for the average man, not too much money.

In order to bring out another phase of this subject I intend to extend the interpretation of the word "preparation" a little further than Dr. Jackson has done, and I am not borrowing from Mr. Ford when I do so, for I have preached it for a dozen years or more. If the younger man were to ask himself what will be my station in ophthalmology and how shall I be regarded by my fellow practitioners when I am 40 years of age, rather than how much money will I be making at the expiration of 5 years, I believe Dr. Jackson could well lament the loss of 200 ophthalmologists each year. The fact is if such a policy were pursued the individual ultimately could not keep the dollars away and he would long for more time for work in his study, hospital or laboratory, as the case might be. If we could train 100 such men each year I am sure they would offset in accomplishments and efficiency the 200 who have been trained as heretofore and who are passing on each year.

Dr. Jackson, doubtless to be less direct, has placed more emphasis on the lack of facilities for adequate preparation. To my mind, the other side is an important one, and that is the lack of men who desire or who can arrange to be adequately trained, early. Should the time ever come, and I do not believe we have reached it, where the demand for such training exceeds the facilities, I believe suitable opportunities will be provided. My own opinion is that if we have adequate facilities for properly training 75 men a year along the lines suggested, we have ample to meet our present demands. These schools should be supplemented by such instruction as is provided in the excellent short course in Denver. A similar course should exist in the East. In addition to this, certain institutions should devote their time to 3 to 6 month courses for training along special lines of work. In my opinion, this is the type of instruction that anyone of the 77 institutions referred to, might participate in.

I personally believe that with such institutional facilities in conjunction with the other methods of instruction now available, no one need leave this country for any fundamental training. Foreign study should be reserved for several years later, when the individual's experience permits him to discriminate as to his material, or follow particular lines in which he may be interested.

THE CATARACT OPERATION

A Study of Details[1]

WALTER B. LANCASTER, A.B., M.D., F.A.C.S., Boston

WE study the cataract operation to improve our results. At long intervals some radically new procedure makes for better results; at shorter intervals minor but important improvements are devised. But if we look for the explanation of the fact that some surgeons have better results than others, we shall find it in a multitude of details rather than in some special procedure, so that we must study the way the successful surgeon carries out the *details* of each procedure if we would find the secret of his success. Conversely, when results are less than first rate, a surgeon may have made a wise choice among the many alternative methods of performing the various steps of the operation, but because he fails in some of the details in carrying out these procedures, his results are disappointing.

If we consider the causes of poor results we shall find that most of them may be attributed to two things: mechanical defects and inflammation.

The mechanical defects may be a poorly executed section or other step in the operation due either to the surgeon himself—poor technique; or to the patient—bad acting. These factors result in imperfect healing, in prolapse or entanglement in the wound of iris, capsule, or vitreous, and in incomplete removal of lens material—imperfect toilet.

Inflammation may be the result of one or more of the following: infection, more or less mild; lens remnants left in the eye; endogenous sources; trauma due to heavy handed manipulation; and trauma due to postoperative accidents.

We cannot attempt to review all the details involved in the different methods of the cataract operation, but we will choose some of those most likely to need attention.

The best results cannot be attained without skill, manual dexterity, the ability to execute with delicacy and precision, with exquisite co-ordination and lightness of touch. Such ability is in part a natural gift and in part acquired by intelligent training. However, fairly good results can be obtained by surgeons of only moderate skill. The best surgeons seem always to have an easy time, because they spare no pains to have everything so arranged as to make it as easy as possible to do what they have to do. For example: it is important to see clearly what you are doing, and this necessitates having good lighting and suitable glasses for the operator; the knife should be good and the eyeball steady. A steady eyeball—a detail neglected by the majority of operators—is especially important for that makes possible, even if the knife is not perfect, a good section and a good section has long been regarded as the most important step in the operation. The skillful surgeon can manage to secure a good incision in spite of a wobbly eyeball. The wise surgeon will avoid the necessity of using extra skill, even if he possesses it, just as he will avoid the handicap of a poor light, an awkward position, imperfect instruments, or clumsy assistants.

There are several ways of securing good fixation, but all depend on fixing more than one point. In making a section in an unattached eye, three point fixation is needed. When the eye is in its place in the orbit one point is already fixed, namely the center of rotation of the eye. To prevent rotation of the eye two more points should be fixed. This can be done by a double fixation forceps; or by two fixation forceps, one held by an assistant; or by a fixation forceps and a bridle stitch held by an assistant. I like the double fixation forceps, and while I do not know of any perfectly satisfactory model, I hope some time to design one. An effort is made to grasp some subconjunctival tissue close to the cornea just below the horizontal meridian on both sides. If conjunctiva only is seized, it is very easily torn. Attempt should not be made to pull the eye into position against the re-

[1] Presented before the Clinical Congress of the American College of Surgeons, Philadelphia, October 13–17, 1930.

sistance of the ocular muscles. The patient should be coaxed to look in the proper direction, and the eye should then be held in that position against the push or pull of the knife. If the eye is deep seated, it is possible with a good grasp of it to pull it appreciably forward where it is easier to make the section.

If two forceps are used, the surgeon first fixes the superior rectus at least 8 millimeters from the cornea. It may be necessary or helpful for the assistant to pull the eye down far enough for the surgeon to get at the point he wishes to grasp, in case the patient does not look down when requested. The assistant, if he is in front, can reach up a little way under the upper lid and grasp the conjunctiva enough to pull the eye down where the surgeon can apply his forceps to the superior rectus; or the surgeon can take two forceps, one in each hand, pulling the eye down with the right hand far enough to get the desired hold with the left. The assistant then fixes the internal rectus about 7 millimeters from the cornea. He tests his fixation by moving the eye with his forceps to see whether the forceps have a proper hold. If not, they drag the conjunctiva while the eyeball lags. If the hold is a good one the eyeball moves with any movement of the fixation forceps without any lag or any shifting or sliding of the conjunctiva. If the assistant is unable to take a grasp deep enough to include the muscle or capsule firmly in his forceps, perhaps because the conjunctiva is ballooned up by subconjunctival injection, he must abandon that point and secure a hold close to the cornea where the conjunctiva will not slide. Less strain will be put on this delicate conjunctiva if, when he has secured his hold, he tilts the handle of his forceps as far as possible toward the nose. Then in resisting the thrust of the surgeon's knife he does it not by pulling but by pushing. As the assistant's experience increases, he will usually succeed in getting a hold of the muscle even when there is some œdema of the conjunctiva. As soon as the surgeon has made his counter puncture, the assistant takes great care not to press on the eyeball and may, after the first forward thrust is completed, release his hold altogether.

Success in grasping the superior rectus or the internal rectus depends, like so many other maneuvers, on the use of a suitable instrument. The slender but strong forceps of Elschnig have points particularly well designed for grasping subconjunctival tissue. I have to thank Dr. Clarence King for calling them to my attention. Another very good model is the Prince fixation forceps. I prefer for this purpose forceps without a catch.

The bridle stitch through the superior rectus is of great value, especially if the patient tends to rotate the eye upward as most patients do. It is easy to apply after a little practice, and should rarely be omitted even if forceps are used to fix the superior rectus while the section is made. It is incomparably better than trying to rotate the eye down by forceps or stitch applied below the cornea. A surgeon who still relies on telling the patient to look down, repeated over and over again (I have counted over 40 repetitions in one operation) in various tones with threats and entreaties, is far behind the times. He probably blames the patient as a bad actor!

Bad acting, probably the most prolific cause of mechanical troubles, makes it hard for the surgeon to carry out his maneuvers and thus causes loss of vitreous and other disasters. Not enough attention is paid by most surgeons to the *prevention* of bad acting. I take the position that bad acting is preventable and is the surgeon's fault. For many years I have blamed myself when a patient acted badly, so that it has become a rare occurrence.

Bad acting is a reaction by the patient. We should control the patient's reactions. My aim is to secure a patient who cannot feel, does not want to move, and could not move if he tried. There are three ways of controlling a reflex: (a) through the sensory arc by local anæsthesia; then the patient cannot feel; (b) through the motor arc by akinesia; then he cannot move; (c) by reducing the sensitivity of the higher centers by sedatives; then he does not want to move even if he could. The procedure I follow is this:

The day before the operation on entering the hospital, the patient is given 5 grains of barbital, again, at 7 or 8 p.m., 10 grains of barbital. The first dose is to allay the nervous-

ness felt on entering the hospital. Sometimes this nervousness calls for treatment several days before. In such cases luminal may be given twice a day for several days in 1½-grain doses. The dose at 7 or 8 p.m. insures a good night's sleep. The nurse has instructions to give more during the night if needed; but it is very rare that 15 grains of barbital in divided doses is insufficient.

If necessary, a cleansing enema is given the night before, not the morning of the operation. Two and one-half hours before the operation, 10 grains of chloretone is given in suppository. One and one-half hours before the operation between 6 and 12 grains of sodium amytal is given by mouth, and is followed by a copious hot drink. Soon after this a light breakfast is served. Half an hour before the operation ¼ to ½ grain of codeine, and 1/200 or possibly 1/150 grain of hyoscine is administered hypodermically.

The dose of sodium amytal depends on several things: (a) the effect obtained from the barbital the night before—if this is slight to moderate, a larger dose of sodium amytal is given; (b) the size and age of the patient; (c) the nervous system of the patient, a larger dose being given to the excited or apprehensive patient. I see no need for giving the sodium amytal intravenously. It agrees when given by the mouth and is readily absorbed. If in doubt as to the patient's stomach, I give the night before instead of the cheaper barbital, 6 grains of sodium amytal in divided doses to observe how it is tolerated. The average dose is 3 grains, the maximum dose is 25 grains. Even 15 to 20 grains intravenously may be followed by disagreeable symptoms—excitement, depression, danger of swallowing tongue, etc. I have seen none of these results in the doses I have used, but in one case I had carbon dioxide administered several times to stimulate deep breathing as a preventive of pulmonary complications, to which the patient was subject. I frequently advise the patient to breathe deeply several times a day; and I insist on having the patient sit up in bed a few hours after the operation for as long as the patient wishes.

The codeine and hyoscine are not to be given if the nurse finds that the previous medication has produced a fairly profound impression; and the dose of ¼ to ½ grain of codeine and 1/200 to 1/150 hyoscine is regulated by the effect already obtained. The hypodermic may be postponed until I see the patient. In order to favor the sedative effect, the patient is kept quiet, with no talking and no preparation going on in the room. The patient is moved to the operating room in his bed and disturbed as little as possible.

This preliminary treatment is what I have called in earlier papers "*mental*" anæsthesia, but is now called "*basal*" anæsthesia.[1] Lundy, of the Mayo Clinic, has stressed the wisdom of using several drugs in moderately large doses instead of one drug in a very large dose. This is the treatment designed to reduce the activity of the reflex centers. The local anæsthesia is no less important. Cocaine 4 per cent is instilled three or four times at intervals of two or three minutes; and if there is any hyperæmia, one drop of 1:1000 adrenalin is used after the first dose of cocaine. Seven or eight minutes after the first cocaine instillation the eye is tested, and if anæsthesia is sufficient to make it painless, a subconjunctival injection of cocaine 1 per cent and adrenalin 1:10,000 is made, about 3 drops, 0.2 cubic centimeter, both above and below the cornea but not near the cornea, well back. This is massaged through the closed lids to diffuse it.

The other preparations are made, such as instillation of antiseptic (not mercurochrome, as it acts on cocaine to produce an irritant), irrigation of the conjunctival sac, clipping the lashes from the outer and inner quarters of the lids, and injection of procaine for akinesia. After the irrigation, one or two more instillations of cocaine are made and the eyes are kept closed. After a few minutes the pupil should show signs of dilating by the action of the cocaine and adrenalin. This is the sign that the anæsthesia has reached the deeper parts of the eye and also that the pupil will permit the lens to pass through it.

In a few cases additional precautions are taken. Procaine 2 per cent with adrenalin 1:20,000 is injected intra-orbitally inside the muscle cone just behind the eyeball to produce

[1] See articles by Lundy and others in the Proceedings of the Mayo Clinic during the past two years, especially December 18, 1929.

some akinesia of the external ocular muscles and some additional anæsthesia. Still more rarely do I paralyze the orbicularis. The reason I omit the procaine injections in most cases is that I have found them unnecessary when the basal and local anæsthesia are well done. In other words, if I have a patient who cannot feel and does not want to move, it is not necessary to fix him so that he could not move if he tried. I am fairly sure he will not try. If not sure of this, it is better to secure some degree of akinesia of the extra-ocular muscles (which as I have often said are the most dangerous cause of expulsion of vitreous in squeezing) and also of the orbicularis. It is probable that the orbicularis can be more easily reached and more certainly paralyzed, and with less liability to spasm of Muller's muscle, if the injection is made by O'Brien's method as advised by Colonel Wright. Another effect of intra-orbital injection of procaine and adrenalin is the marked reduction of intra-ocular pressure. This is very desirable if not allowed to go too far. One of the chief advantages of procaine around the lids is that in addition to some akinesia you get a good deal of anæsthesia; so that manipulation of the lids is not felt by the patient—for instance, a too widely opened speculum which would otherwise be very painful and so cause bad acting.

It will be noticed that while I give much larger doses of sedatives and perhaps of local anæsthetics than most ophthalmic surgeons, *I feel my way* as it were, starting with small doses, observing their effect, and never giving very much at one time. The after-effects are good. The patients are much pleased. Sedatives are continued for several days until the danger of trauma is passed. I have had no bad effects from using too much, but I have often used less than would have been ideal.

So important is this matter of good basal and local anæsthesia and akinesia that it has revolutionized our attitude toward many of the steps and details of cataract operation. No longer is speed an all important consideration, lest the patient at any moment act badly, so that the sooner the operation is over and the eye closed, the better. Instead we can take time to insert complicated or difficult stitches, time for meticulous toilet, for leisurely removal of cortical débris by manipulation or by irrigation, confident that if anything calamitous occurs it will not be the fault of the patient but of the surgeon or his assistants. Hence the widespread adoption of the intracapsular operation and the use of a stitch for the closure of the incision. Hence the confidence with which we attack complicated cases, doing operations which under the old conditions would have been not only bold but even reckless. Hence a preliminary iridectomy is with me a great rarity. Hence the need of an assistant to hold the lids rarely exists and a suitable speculum is better, and sometimes it is even unnecessary for the speculum to be supported by the assistant.

With good basal and local anæsthesia, with or without some akinesia, and with good fixation, it becomes easy to make a good section. A good section should lie just posterior to the limbus, so that it is in conjunctiva throughout its length. The conjunctival flap should be about 1 to 2 millimeters wide at its narrowest point—the point of puncture and counter puncture—and 4 to 5 millimeters wide at the summit.

The size of the section is a detail of much importance. Formerly it was thought that the smaller the section, the less the danger of its suppurating. Today we know that a large incision is not as great a source of danger as too small an incision. Two-fifths of the cornea is usually enough unless you are planning to extract in capsule, in which case nearly half of the cornea should be the size of the section. Formerly it was advised to make the section so that it was as nearly as possible as large on the inside as the outside. To help toward this and to help overcome the difficulties of imperfect fixation (single forceps fixation), it was advised to start the puncture with the knife pointing toward the center of the lens. As soon as the point entered the anterior chamber, the handle was lowered as the point was moved steadily onward until the blade was horizontal and parallel to the plane of the iris. This maneuver is entirely unnecessary and adds much to the difficulty of making the section. It conflicts with our principle of *making everything as easy as possible*. Hence the

best way is, first, to start the puncture with the knife parallel to the plane of the iris and parallel to the horizontal diameter of the cornea, its point about 2 millimeters back of the limbus but always anterior to the iris and 1 or 2 millimeters above the horizontal diameter of the cornea, depending on the size of incision desired; and second, to push it straight across the anterior chamber, keeping parallel to the iris and so making the counter puncture at a point symmetrical with the puncture.

One can pause an instant at this point to make sure that the knife is in its proper position parallel to the plane of the iris, so that its cutting edge is directed upward in the precise direction we wish to make the incision. The knife should then be pushed onward and upward, so that it cuts both with the part near the point and with the part near the heel of the blade, the former part cutting the nasal side and the latter the temporal side of the section. Of the two, the nasal may be cut a little faster than the temporal side. One reason for cutting more on one side than on the other, instead of both equally, is that it is possible to watch one side more carefully and exactly than both, and the operator is thus ready to correct any tendency of the knife to depart from its proper path and thus cut too far forward or too far backward and spoil the section. If the operator is sure he can make the section in the proper plane, it is better to cut both sides at once. It is important to reach the top of the anterior chamber, or at least to pass the edge of the pupil, with the first forward and upward thrust made rapidly, before the aqueous has escaped enough to permit the iris to move forward where it will be lacerated by the knife. By this time nearly all the aqueous has escaped, but as the knife has passed the edge of the iris and has reached the top of the anterior chamber, no inconvenience is produced at this stage, and the incision can be completed in a more leisurely fashion, with less and less force, so that when the last few fibers are severed there will be no sudden jerk as the knife slips past the sclera and comes to be under the conjunctiva. The conjunctiva is cut by turning the edge of the blade forward and gently sawing through at the desired distance above the limbus, 4 or 5 millimeters. If a corneoscleral stitch has been placed it will be necessary to come out exactly between the two parts of the stitch, and this step will not be difficult if the incision is completed very slowly.

In making the section two things are of major importance: a sharp pointed, sharp edged knife, and good fixation of the eyeball. The good surgeon will make sure that both conditions are taken care of.

Before the section is made we must decide whether we wish to use a suture for the wound, and if so, whether we wish to place it before making the section or after. This opens a large subject, sufficient for a paper in itself.

Let us consider what the suture is for. Ellett, one of the surgeons who has longest and most consistently used a suture, states that the chief advantage of it is the greater freedom with which cortical débris can be removed; that is, it facilitates the toilet of the anterior chamber. Harold Gifford stated that suture does not prevent or reduce the incidence of prolapse of vitreous at operation, but it may limit the amount both at the time of operation and after. Various surgeons have stated that the suture does not prevent prolapse of iris.

On the other hand, if the wound is closed securely, accidents during convalescence are less likely to be disastrous, and patients can be given more freedom soon after the operation. Derby points out the protection from damage by excessive coughing, vomiting, sneezing, etc., and from such accidents as falling out of bed.

Without attempting to strike a balance between the advantages and disadvantages, it may certainly be stated that the use of a suture is increasing very rapidly in all parts of the world. It is my opinion that the great advantage of secure closure of the wound is in reducing postoperative complications. Adequate basal anæsthesia, local anæsthesia, and akinesia make it possible to avoid the mechanical difficulties during the operation, except such as are due to the awkwardness of the surgeon or his assistants. The surgeon can work as deliberately and meticulously as if he were operating on a cadaver. Now and then there is an exception, and a suture will

be wanted during this stage, for example, in presence of prominent eyes, high myopia, fluid vitreous, and unruly patients.

In my experience with cataract operations during the past 20 years, I have found my greatest trials during the postoperative period. There are four ways by which we may guard against postoperative complications: (1) Careful attention by competent nurses. While such care is of great value, it is not possible for a nurse to be so watchful and alert that she can unfailingly stop a patient from harmful acts and too much reliance should not be placed on this safeguard. (2) The use of sedative drugs may be kept up for several days and should be unless there is found to be some contra-indication. A judicious selection of drug and dose is invaluable if the patient becomes delirious or demented. (3) Suture of the wound is an important safeguard if it is so placed that it effectually holds together the lips of the scleral wound. (4) Protection of the eye by means of a dressing of some sort that makes mechanical injury very difficult, as by the finger of the patient or by any fortuitous blow or pressure over the eye.

Undoubtedly a suture of the conjunctiva is of some value. Whether it is of great value seems to me doubtful. A good conjunctival flap will become adherent in a few hours, without a stitch. The upper lid is an ideal splint to hold the flap in place, especially with a well fitting dressing containing a wet pad accurately fitting and gently pressing on the lid. During these first few hours the patient should be sleeping or resting quietly under the influence of say amytal or other barbituric compound as a sedative, and acetyl-salicylic acid or codeine to control the pain which is usually present the first day. However, without a suture there is some risk of the flap's being displaced, especially inverted, thus favoring the downgrowth of epithelium through the wound. There is probably more risk that the scleral wound will separate somewhat under the flap when the flap is not sutured than when it is. Conjunctival suture has been taken up enthusiastically by Barraquer, by Elschnig, and by some of the Vienna operators, and of course it is widely advocated in this country.

On the other hand, the suture which holds the sclera and not simply the conjunctiva is a far more secure and dependable safeguard. It is much more difficult, since the thread must be in place before the eyeball is opened; whereas a conjunctival suture may safely be placed after the section has been made and even after the lens has been removed, provided the anæsthesia is satisfactory.

Of the sclerocorneal sutures I have seen, Verhoeff's[1] modification of the Kalt seems to me the most secure and most accurate in coaptation. It sacrifices the conjunctival flap except for the middle third of the incision, but the part left without a flap is certainly not the most important part to cover. I have not had sufficient personal experience with sutures in closing cataract incisions to pose as a judge. I can only say that my practice is to use a suture in the exceptional case, not as a routine. My reasons are that in the routine case, during the operation, it is rendered unnecessary by good anæsthesia, that after the operation the rather extensive conjunctival flap becomes rapidly adherent by fibrin, followed by early tissue growth. Now and then a postoperative accident makes me wish I had had a suture; but to be fair I must tell you that I have seen postoperative accidents resulting in prolapse in eyes *with* sutures and operated upon by devotees of the sclerocorneal suture. In other words, it is by no means the sure thing that you might infer if you read without a grain of salt the descriptions and claims.

Let us consider the treatment of the iris. We have three things to look out for.

1. The pupil should be large enough to permit the passage of the lens. This sometimes requires that the sphincter of the iris be cut, but usually if the pupil is dilated by subconjunctival cocaine and adrenalin it will be large enough. The assistant should stand ready with a small Stevens muscle hook, or other suitable instrument, to ease the edge of the iris over the lens at a word from the surgeon, or if it is a capsulotomy operation, with a smaller hook or capsulotome to ease out the lens by a rotary movement as the surgeon presses it into the wound. Safar thinks

[1] Tr. Am. Ophth. Soc., 1927.

homatropine is essential. Both Elschnig and Barraquer use it or euphthalmine. I prefer not.

2. The iris should be treated with a view to the prevention of prolapse. A regular iridectomy does this, while at the same time it provides a large enough pupil for the passage of the lens. But a basal buttonhole iridectomy which does not cut the sphincter is even better as a preventive of prolapse, but worse than useless as an aid to the passage of the lens. It was originally done by Chandler, its inventor, after the lens had been extracted, to avoid the embarrassment of the lens catching in the buttonhole instead of taking the proper route through the pupil.

3. For the best results the pupil should be round, central, and active. This sometimes results from a simple extraction, but the percentage of prolapse in simple extraction is large. Hence the basal buttonhole iridectomy is gradually supplanting all other methods, since it fully answers (2) and (3), while (1) occasionally requires that the sphincter be cut.

Another and very great advantage of the basal iridectomy over the regular iridectomy is the protection against tags of capsule adhering to or becoming entangled in the incision when a capsulotomy operation is done. Treacher Collins has emphasized the bad results from tags of capsule getting into the wound. He has advised the simple extraction, being willing to run the risk of the greatly increased percentage of iris entanglement for the sake of escaping the danger of glaucoma and other possible consequences of capsule entanglement. Basal iridectomy gives protection against the capsule complications and at the same time avoids most of the iris complications. Furthermore, there is less tendency for the iris to be drawn up because of displacement of the vitreous upward. Replacing the iris tends to push the vitreous back where it belongs. A little massage over the upper part of the cornea and wound may be cautiously used to aid the tissues to return to their normal relations.

Buttonhole iridectomy was first practiced by Chandler, of Boston, 40 years ago, but it did not gain great favor until Hess, following Pflueger, took it up. Because of Hess's powerful influence a large number of surgeons gave it a trial. Elschnig does a basal iridotomy by means of the de Wecker scissors. This technique was tried by Safar, who at first followed Elschnig's method very closely, but soon found that a buttonhole iridectomy gave very much better results (iridotomy, 20 per cent prolapse in 27 cases; buttonhole iridectomy, 0 per cent in 23 cases; he admits that the iridotomy was not correctly done in all cases).

As I was for some years Dr. Chandler's assistant surgeon at the Massachusetts Eye and Ear Infirmary, it was natural that I should adopt the buttonhole iridectomy; and it is very gratifying to find it now being taken up in Germany and Austria, in India, and in fact in all parts of the world.

I have been doing the intracapsular extraction for 14 years, at first in a small proportion of cases, and later in a very large proportion of cases. I have watched with interest the reports of results of intracapsular extraction by various surgeons and have been surprised at the small number of positive and positive negative results.[1] The figures ranged from 25 up to 60 per cent. Recently better results have been reported; and as I have studied the descriptions given, it has seemed to me that the improvement was due to a little detail of much importance, which is not described in the earlier papers except in my discussion of Török's and Verhoeff's original papers, and in Safar's[2] and Verhoeff's[3] latest papers. Their results, showing Safar 88 per cent and Verhoeff 80 per cent of positive and positive negative results, are the only ones except Elschnig's which show over 75 per cent. These improved results are due, I believe, to a detail in technique which has been adopted I am sure by Safar, perhaps by Verhoeff, and possibly in part by Elschnig. The detail to which I refer is this. The application of counter pressure on the outside of the eye when the forceps are pressed gently against the lens to grasp the capsule, and then of continued and stronger pressure on the outside to aid the forceps in

[1] Elschnig calls those cases positive when lens and capsule come out intact; positive negative, if the capsule ruptures when the lens is partly out and yet is extracted in spite of the tear; negative, when the capsule is torn and the lens is expressed without the capsule.

[2] Safar. Ztschr. f. Augenheilk., 1929.

[3] Verhoeff. Tr. Am. Ophth. Soc., 1927.

dislocating the lens. This is a step which we advocate and it is my opinion that the secret of a large percentage of successes lies in the skill with which this pressure on the outside is co-ordinated with simultaneous traction on the inside.

As I have not seen a description of the evolution of the intracapsular procedure, it may be permissible to outline this evolution to help throw light on some of the details. Knapp and Stanculeanu, in 1910, independently first hit on the idea. They were both using forceps in doing capsulotomy, aiming to tear off as large a piece as possible of the anterior capsule. In doing this they noticed that there was a tendency to subluxate the lens. Both Knapp and Stanculeanu were interested in the Smith operation, and so it occurred to them that if the lens were first "loosened" by the blunt capsule forceps, it would then be easier and safer to express it in the Smith way. This explains why all the early exponents of the use of the capsule forceps to break the zonule laid aside the forceps as soon as the lens was subluxated and completed the operation with instruments of expression (spoon or hook). Even Török, who first advocated retaining the forceps in the left hand with a firm hold of the capsule, and Verhoeff, who early adopted Török's method, advised using the forceps to "subluxate" (Knapp), to "loosen" (Török), to "lift forward" (Verhoeff), the lens before applying pressure outside. At the meeting of the American Ophthalmological Society, in 1916, when Török and Verhoeff read their first papers on the Török method, I discussed these on the basis of my experience with the method and strongly recommended for the first time, and at some length, that pressure be applied on the outside of the eye at the very beginning, not waiting until the forceps had "loosened" the lens. There are two reasons for this: First, the counter pressure on the outside supports the lens when the forceps are pressed against it to obtain a grip of the capsule. In this way there are fewer failures to secure a hold of the lens, and there is less danger of dislocating the lens by pressure with the forceps before they have grasped the capsule. In most cases it is very easy to grasp the capsule, but it is very difficult or impossible in plump lenses with the capsule not easily indented enough to get a small fold of capsule between the jaws of the forceps. It is difficult also in soft eyes, because the lens gives when you try to grasp it. It becomes easier to grasp the capsule when counter pressure is used. But if the pressure is so used as to make the capsule more tense, then it becomes harder to grasp the capsule. This, it appears, may happen in Verhoeff's method. Second, it requires less traction by the forceps on the capsule to rupture the zonule when to this traction is added the tension produced by the pressure on the outside of the eyeball.

Elschnig, like the American writers, expressly states that he grasps the capsule with the forceps and cautiously moves it to and fro about 3 or 4 millimeters, allowing about 10 or 15 seconds for this stage, after which he first begins to pull slowly forward and upward, while at the same time a gentle pressure is applied with the hook against the cornea on a level with the lower edge of the dilated pupil. It is not clear from this whether he always waits until he has ruptured the zonule before applying pressure, or whether he uses pressure to help rupture the zonule. Since he applies the pressure so high up (margin of pupil), it seems probable that the former is true; but judging from his excellent results (77 per cent+ and +−) he uses pressure lower down to help dislocate the lens.

Knapp[1] as late as 1928 says: "All intracapsular methods now in vogue start with the dislocation of the lens. . . . According to the Smith method, this dislocation is accomplished by external pressure. . . . The second method is the dislocation brought about by the capsule forceps. This is the safest method, but only succeeds in dislocating the lens in a proportion of cases, as the capsule tears. Finally, the dislocation has been effected by the vacuum cup." If he had known about my practice, he might have inserted before "Finally": "There is a third method, practiced by Lancaster" (it had not then been done by Safar, who only began intracapsular extraction in 1928) "which combines these two methods. Pressure on the outside is applied simultaneously with the grasping of the capsule by the

[1] Tr. Am. Acad. Ophth. & Oto-Laryngol.

forceps. In this way the dangers of the Smith method are avoided, and since less traction by the forceps is required, the capsule is torn in a smaller number of cases."

Verhoeff has described a method of extraction with combined outside pressure and traction by forceps which has yielded him only a small percentage of failures in extracting both lens and capsule. He first exerts enough pressure to cause the upper margin of the lens to be plainly visible in the wound. He then grasps with the forceps the lens at or near its equator at the top, and pulls the lens by the forceps and pushes it by the hook. With his method, vitreous losses have, of course, been large; but he has succeeded in extracting lens and capsule together in 80 per cent of the cases. It will be noticed that this large percentage is the result of a technique involving simultaneous pressure and traction. I suspect that Verhoeff used pressure to aid in dislocation of the lens before he adopted his present method; but I have found no statement to that effect in his writings.

I fancy that many who have done much extraction in capsule now use the pressure of the outside instrument to help dislocate the lens, though Safar,[1] of Meller's clinic, is the only one who mentions particularly applying counter pressure outside as an aid in grasping the capsule. At the time of my discussion no one had described using the outside pressure to aid in rupturing the zonule. This accounts for the small percentage—25 per cent to 60 per cent—of successes in the early reports of intracapsular extraction by this method. Elschnig (1928) reports 77 per cent, and Safar (1929) 92 per cent. My own results, though very good, are not so good as Safar's. However, Safar, who reports no vitreous losses, omits two cases (4 per cent) in which he had to use the loop. He had no iris prolapse when he did the Chandler buttonhole (20 cases), but 20 per cent prolapse when he did the Elschnig incision of the iris root. He had 82 per cent of round or nearly round pupils.

	Per cent		Per cent	
Elschnig reported	77 + or + −		3.4	vitreous
Verhoeff reported	80 + or + −		5	vitreous
Safar reported	88 + or + −		4	vitreous
Elschnig in 100 consecutive			1.45	vitreous

[1] Ztschr. f. Augenheilk., 1929, p. 157.

I believe that the secret of a large percentage of "positive" results lies in the skillful apportionment of inside pull and outside pressure *simultaneously* exerted. I have called attention to this several times since first mentioning it in 1916. It may be that it is in more general use than I imagine, but the fact that Safar is the only other one who has called attention to this detail and is the one who has reported the largest percentage of "positives" makes me think that the point requires further emphasis.

Wright[2] has said; "It often happens that a valuable practical procedure which appears in current literature is regarded by the majority of readers as a matter of passing interest, unless it is not only endorsed but emphasized."

If I were to sum up the question of the intracapsular versus the capsulotomy operation, I should say that when done as I have outlined it it is much the best cataract operation yet devised. It requires more skill, is harder to learn, and harder to teach. It is not to be recommended, therefore, for universal adoption. Only those should use it in whose hands it gives better results than the capsulotomy method. Usually a surgeon should first learn the capsulotomy method. When he has mastered that and acquired considerable experience and facility in operating, he may begin cautiously to do the intracapsular operation. By *cautiously* I mean in cases selected as particularly easy to do and well suited to the intracapsular method; such are immature but not swollen cataracts in patients over 65 with eyes that are not prominent and who are likely to be good actors.

When he has done the operation for a good many years, he is likely to feel that it is for him the operation of choice in difficult cases. For example, in a patient who has lost one eye through inflammation, and perhaps has had some iritis of the eye to be operated upon, in which the cataract is still immature, I prefer to extract in the capsule, without preliminary iridectomy, provided there is not reason to suspect fluid vitreous and provided the eyes are not very prominent. This is not foolhardy or even bold. It is the result of careful consideration of the dangers involved and of my

[2] Arch. Ophth., ii, 69.

experience in meeting them. Removal of the whole lens greatly reduces the risk of post-operative inflammatory reaction, which is the chief danger in such a case. The danger of vitreous loss in my hands is hardly appreciably greater than in the capsulotomy operation, with expression of cortical and irrigation, except when there is fluid vitreous. If I found that the patient proved to be a bad actor in spite of my preliminary medication, I should change my plan after the operation had begun. I have used the intracapsular operation in a good many of these complicated cases, and have never had cause to regret it. Hence I say my choice is not a foolhardy one; it is not even bold; it is a truly conservative choice on my part. It is the operation by which I believe I can give the patient the best chance of a good result. I do not mean by that that the number of brilliant results will be larger at the cost of a goodly number of disastrous results, but that the number of poor or disastrous results will be smallest if I operate in that way, and experience has justified my choice. Of course, as stated above, I do not recommend it for universal adoption. If it were known, as it will be in time, that the lens can be extracted successfully in so large a proportion of cases, there would be fewer who try to accomplish the result in the more dangerous method of suction with vacuum cup.

Because the extraction with the vacuum cup, while it gives a large proportion of brilliant results, gives a fatally large proportion of bad results, it is not in my opinion worthy of general adoption; on the other hand the intracapsular, as described, is both brilliant and safe; my proportion of failures is not as large as with the old capsulotomy operation.

DISCUSSION

EUGENE M. BLAKE, M.D., New Haven, Connecticut: A divine discontent with conditions as they are, no matter how satisfactory, is the mark of a healthy mind. The surgeon, above all others, should never be entirely content with his technique or methods. The very nature of our work and the inestimable value of the organ upon which we operate makes us inherently conservative. For this reason we are prone to follow established customs and it is only by trying out newer methods in properly selected cases that real progress can be made.

It seems to be universally agreed that the *study* of an individual who is to undergo an operation for the extraction of cataract should be painstaking and thorough. The removal of evident foci of infection and proper preparation of the eye are prerequisites and this phase of the subject has been ably presented. The administration of bromides or sodium amytal the night before operation is helpful in aiding to give the patient a restful night's sleep and to prevent undue excitement on the day of the operation. Personally, I do not care to use morphine, codeine, or hyoscine just before operation for fear that what may be gained in the way of depression of the mental activity of the patient may be lost in the ability to co-operate at a critical time.

Even at the risk of repetition I would like to stress what Dr. Lancaster has said regarding the surgeon's relation to the behavior of the patient. Having induced thorough anæsthesia of the ocular tissues the next factor in importance (disregarding manual skill, of course) is that intangible something, the personality of the operator. The lack of any uncertainty of manner on the part of the surgeon and an optimistic bearing, plus positive orders as to what to do, instil in the patient's mind a fortitude and degree of co-operation which technical skill alone cannot impart.

While total akinesia is difficult to secure, I have found that novocain injected at the outer orbital rim and along the lid margins produces a sufficient weakening of the orbicularis and the accessory muscles of winking, to prevent dangerous squeezing. I have never found it necessary to suture the lids following this procedure.

For proper anæsthesia of the iris I prefer to inject novocain, rather than cocaine, subconjunctivally, because it can be well sterilized, is less toxic, and gives as good effect. The subconjunctival injection of an anæsthetic solution is one of the greatest advances in our technique for with surface anæsthesia by dropping cocaine into the conjunctival sac the iris is rarely insensible to pain and the patient usually squeezes and rolls the eye when the iris is drawn out of the wound—becoming thereby a "bad actor." As to deep orbital injections, or paralysis of the ciliary ganglion, I have little experience. The protrusion of the globe, the possibility of injury to a fairly large vessel, and the frequent hypotony resulting seem to me to more than outweigh the advantages which its advocates claim for it. Cocaine for surface anæsthesia, novocain subconjunctivally and in the lid muscles afford all that can be demanded in the avoidance of pain and prevention of squeezing.

It was, I think, Landolt who said that the incision *is* the operation of the extraction of cataract and certainly all agree that a well executed incision is the greatest single factor in the surgical procedure. Double fixation of the globe adds greatly to the ease of making a good section. I have not tried two pairs of forceps as Dr. Lancaster recommends, nor the bridle suture, but shall surely do so. In my hands the double forceps have an unpleasant trick

of tearing out on one side, especially in the friable senile conjunctiva, and this makes an awkward fixation with only one branch of the forceps holding. If two points on the globe can be fixed, however, the section will be more accurately placed. When sutures are employed a large conjunctival flap is not necessary and it sometimes bleeds freely and is in the way.

Capsule forceps to remove as much of the anterior capsule as possible rank far ahead of the cystotome in permitting extraction of the lens and removal of cortical matter.

The peripheral iridectomy, performed *after* the removal of the lens, cannot be too strongly recommended. The better cosmetic result, the prevention of dazzling which must occur with the large keyhole pupil after full iridectomy, the prevention of incarceration of tags of capsule in the wound, and the greatly reduced tendency to iris prolapse through retention of the sphincter pupillæ, seem to me sufficiently good reasons for this refinement in technique. It is the method of choice of such operators as Hess, Meller of Vienna, Bajardi, Barraquer, and others.

Sutures are indicated, as in any surgical incision, and their regular employment for 6 years only makes me a firmer advocate of their application. Each operator will develop his own manner of placing the sutures and will modify his procedure with time and experience. I like to place the first bite of the suture in the episclera, 5 millimeters above the limbus, before making the section, and catching up the flap as soon as the section is completed. One suture is always desirable and two or three are better. The second and third are so easily placed that there is no reason for omitting the extra security which they offer. The sutures greatly reduce the time of wound closure, allow free irrigation of the anterior chamber with removal of lens remnants, and lessen the danger of iris and vitreous prolapse. If allowed to remain in place for a week, the removal of sutures is safe and easy.

I regret to admit of little experience with intracapsular methods of extraction but if such can be made safe they seem to be a consummation devoutly to be desired. The Stanculeano-Knapp-Török method of lifting and pressing out the cataract appears the most likely to be the operation of the future, and I believe that we should cautiously acquire facility in its use.

Finally, if the ophthalmic surgeon can perform a painless extraction of cataract resulting in a clear, black pupil, round and not mutilated, with a wound firmly closed by sutures, he may, perhaps, be permitted to heave a sigh of satisfaction—and seek for other worlds to conquer.

LUTHER C. PETER, M.D., Philadelphia: We are all interested in improving our technique in cataract extraction because refined technique means better results. It is of vital concern to the patient as to whether he may have 6/5 vision or must be content with 6/9 or worse, as to the possibility of secondary glaucoma with its consequences, and especially as to the necessity for two or three operations when one operation should suffice.

The speaker of the morning, Dr. Lancaster, has touched upon some of the vital phases of the operation which will assure the patient the best result for his individual case.

"Bad acting" is a barrier to good results but as the speaker has intimated it is not always the patient's fault. In the hands of a good operator, the anæsthesia is a most important step in the operation. One could speak at length on this subject but after all there are certain underlying principles and the variations are the result of individual ideas and experience. "Basal anæsthesia," the term suggested by Dr. Lancaster, is important but will vary with each operator. After practicing many forms of special preparations, it is my belief that few drugs are harmless. An allonal tablet the night before operation insures a good night, another at 10 a.m., and again one hour before operation brings the patient into the operating room as a rule in a quiet mental state. If this procedure is supplemented by the personality of the operator, which includes confidence, calmness, and kindness, the way is paved for a successful operation if the local anæsthesia is thorough.

My own preference in local anæsthesia is (1) the usual 3 instillations of 4 per cent cocaine; (2) deep ciliary injection of 2 per cent novocain with a small bleb of novocain around the upper limbus, if the blood sugar is within normal limits; or (3) if blood sugar is doubtfully high, 1 per cent cocaine as a substitute for novocain around the upper limbus and the omission of ciliary anæsthesia. When these procedures are carefully carried out, anæsthesia is complete and most satisfactory.

I agree with the essayist that in any form of local anæsthesia the method should be carried out to minutest detail.

As to motor block, little need be said if the lids are held by an assistant and the blepharostat is omitted. The dangerous motor complications arise not so much from the orbicularis, as from retraction of the globe by the four recti muscles. Perfect anæsthesia, gentle manipulations, and confidence inspired by the operator are the surest safeguards against this unfortunate act on the part of the patient.

Next to anæsthesia the most important step in the operation, in the speaker's judgment, is the section which should be generous and finished with a large conjunctival flap. Many an operation becomes indifferently executed because of too small a corneal section, and most of the later complications can be avoided by a good conjunctival flap with sutures.

After trying all forms of fixation, my preference is for a good bite just beneath the point of exit of the counter puncture.

We are especially concerned in this discussion with the procedures which are applicable to any

form of senile cataract extraction. Dr. Lancaster states in his premise that you can improve your operation if you wish by following minutely basic underlying principles. In addition, the old type of operation has been much improved by some of the more modern methods. An intracapsular extraction requires more precision, but the results are so superior that personally I am disappointed when, for one of several reasons, I fail to deliver in capsule. As to the serious question who should attempt intracapsular extraction, the matter can be summed up as follows:

Anyone who can do a good extraction by the older method can acquire the modern technique if he has a fair sized operative practice. If he operates on but six cataracts a year, he will do well to cultivate finished technique in the operation to which he has been trained. The young man with a good surgical hand should acquire from the beginning the finished technique of the modern intracapsular operation. After one has learned how to extract the lens in its capsule, he will never be satisfied to return to the uncertainties of capsulotomy extraction, unless forced to by one of several reasons which may arise.

CRANIAL SINUS THROMBOSIS: OPHTHALMOLOGIC ASPECTS[1]

WILLIAM L. BENEDICT, M.D., ROCHESTER, MINNESOTA
Section on Ophthalmology, The Mayo Clinic

A CONSIDERATION of thrombosis of the great venous sinuses of the head is interesting to the ophthalmologist, although he seldom sees the condition. In thrombosis of the cavernous sinus the ocular symptoms are dominant, and in 10 per cent of cases of thrombosis of the lateral sinuses ocular symptoms are found. With the exception of these conditions, thrombosis and its sequelæ lie outside of the field of ophthalmologic practice. Nevertheless the differential diagnosis of sinus thrombosis is complicated and ocular signs and symptoms are of considerable aid if properly interpreted. Exophthalmos, œdema of the orbit and lids, progressive external ophthalmoplegia with faulty ocular rotation, nystagmus, pupillary phenomena, dimming of vision, disturbances of retinal circulation, and changes in the head of the optic nerve are the most frequently mentioned pathological conditions of the eyes that are to be looked for in a case of suspected thrombosis. The significance of these changes may be decisive if there are other grounds for the conclusion that thrombosis is present, but often these same ocular changes are brought on by other causes. It may be important for a differential diagnosis to be made by one who has had considerable clinical experience in ophthalmologic practice, if proper evaluation of these ocular changes is desired. I shall endeavor to consider in a general way the manner in which, from the standpoint of an ophthalmologist, the ocular signs of thrombosis of the great venous sinuses may be interpreted and to point out the complications that are most likely to lead to confusion.

In a case of complete thrombosis of one lateral or sigmoid sinus the mechanical obstruction to the flow of blood may not produce characteristic changes about the eye. Ablation of the lateral sinus and resection of the jugular sinus is done for relief of infectious sinus phlebitis with thrombosis, without noticeable change in the circulation of the orbit. The same cannot be said, however, of thrombosis of the superior longitudinal sinus or of the cavernous sinuses. Obstruction of circulation in the sinuses that receive the veins of the orbit naturally brings about passive congestion with exophthalmos, swelling of the lids, impairment of motion of the eye, and retinal venous congestion with œdema of the head of the nerve. These symptoms are present in varying degree in conditions other than venous obstruction; namely, orbital cellulitis, tenonitis, periostitis, panophthalmitis, disease of the nasal accessory sinuses, tumors, pseudotumors, and other forms of chronic inflammation. In the presence of chronic infections of the mastoid process or acute infection of the nose or paranasal sinuses, exophthalmos would be regarded as a grave symptom, possibly indicating venous sinus thrombosis, whereas, without such infection, the cause for the exophthalmos would be looked for in the orbit itself.

THROMBOSIS OF THE CAVERNOUS SINUS

Thrombosis of the cavernous sinus is usually first suspected, or becomes probable, after the appearance of swelling of the lids and proptosis, when signs of septicæmia have appeared in a case of infection about the head. It should be borne in mind that absence of ocular signs does not rule out thrombosis, as is attested by reports of necropsy. Following mastoiditis and other affections of the ear, septic thrombosis of the cavernous sinuses occurs with or without thrombosis of the petrosal or lateral sinuses. It is found after disease of the nose and throat, and after infectious processes in other parts of the body. Metastatic abscess of the orbit, and panophthalmitis begin with symptoms similar to those of thrombosis of the cavernous sinus. There is fever, malaise, headache, disturbance of motility of the eye, swelling of the lid, proptosis, and sometimes visual disturbance. The question arises whether the infection is in the orbit or in the cavernous sinus. The symptoms of cellulitis are not always characteristic,

[1]Presented before the Clinical Congress of the American College of Surgeons, Philadelphia, October 13–17, 1930.

but as the inflammation usually proceeds rather rapidly after onset, the tenderness of the globe to pressure and rotation is rather more than is found in a case of thrombosis; in thrombosis the passive congestion of the tissues is due to venous stasis. Intolerance to pressure on the globe, and pain on rotation, are prominent symptoms in inflammatory disease of the orbit, such as tenonitis and orbital abscess; œdema of the lids and proptosis follow after a few hours or days.

Paralysis of the ocular muscles is an early sign in thrombosis. This is due to pressure on the third, fourth, and sixth nerves as they pass through the venous sinuses. Paralysis usually appears later in cellulitis, except in the fulminating type accompanied by rapid swelling of the lids and proptosis. Furthermore, acute inflammatory conditions of the orbit, such as follow acute disease of the nasal sinuses, are seldom bilateral, a valuable point of distinction. Bilateral œdema of the lids is common when infection is limited to one orbit, but proptosis and ocular paralysis involves only one eye. Within 1 to 5 days after symptoms of thrombosis appear in one eye the other eye is involved. When both orbits become involved there is little doubt but that the cavernous sinus is infected unless the swelling persists while the general condition of the patient improves, for it is believed that comparatively few patients who have cavernous sinus thrombosis get well, whereas inflammatory diseases of the orbit are seldom fatal. That the two conditions may exist at the same time or follow one on the other in rapid succession is to be considered. Here again unilaterality of symptoms, more characteristic of cellulitis, may be a deciding factor. In the beginning stage of involvement of the orbit it is often impossible to be sure whether, in a case of suspected thrombosis, the symptoms are dependable, for the patient may be too sick to co-operate in the examination.

Thrombosis of the cavernous sinus is usually first suspected after the appearance of swelling of the lids and exophthalmos. If the retinal veins are distended and the disks are œdematous, the evidence is more conclusive. That the retinal veins are always engorged has been denied by Parsons who further stated: "When it occurs it is usually accompanied by pronounced papillitis and both signs indicate extensive implication of the orbital veins and tissues." Bowers wrote: "Jansen has proved by autopsy that purulent thrombosis of the cavernous sinus is possible with the absence of any change in the fundus, or any impairment of the visual acuteness, or the function of the ocular muscles." Dixon, in 8 cases of thrombosis of the cavernous sinus, found normal eye grounds in 5 cases, bilateral choked disk in 1 case, and right choked disk in 1. The eyes of the one remaining patient were not examined ophthalmoscopically. Patton observed 5 patients with cavernous sinus thrombosis and found engorgement of the retinal veins on the second or third day in every case. In the first case of the series he noticed engorgement of retinal veins, with some blurring and elevation of the disk in one eye only, on the third day of acute illness. Ophthalmoscopic examination, made at intervals of 3 hours during the day, disclosed progressive engorgement of the retinal veins and elevation of the disk. Late in the afternoon involvement of the second eye was noticeable; intraocular changes were present before the conjunctiva and lids were involved. Other observers have reported papillœdema, that is, moderate choked disk in one or both eyes, with venous engorgement of varying amount. In all cases observed by me some engorgement of the retinal veins and some degree of papillœdema were present comparatively late. The prodromal symptoms and the order of their occurrence were given by de Schweinitz as "headache often severe, with or without fever, pain in and around the eyes and the teeth, diplopia and cold in the head." As to the appearance of the fundus he stated, "A true optic neuritis indicates orbital involvement (thrombophlebitis of the orbital veins) but more often the appearances are those of papillœdema, that is moderate choked disc."

Montgomery reported the case of a boy, aged 6 years, whose symptoms of thrombosis of the cavernous sinus appeared about 35 days after the onset of disease of the left mastoid process. Lateral sinus thrombosis followed a

few days after drainage of the mastoid process, at which time the wall of the sinus was inspected and was found to be in good condition. A few days later there was marked left exophthalmos. The eye was fixed and immobile, the pupil was dilated and fixed and there was chemosis of the conjunctiva. Forty-eight hours later the right eye began to swell. The exophthalmos of the right eye was not so marked as that of the left and never became so pronounced. "Ophthalmoscopic examination disclosed mild optic neuritis of both eyes. There was marked fullness of the retinal vein and no abduction in the left eye." Montgomery attempted to drain the cavernous sinus through the left orbit after enucleating the eye, and effected entrance to a pocket of pus, which he drained. Since he did not know whether he had made an entrance into the sinus or not, he put in a drainage tube and awaited developments. The exophthalmos and swelling subsided. The eye grounds later became normal although the child died of meningitis 7 weeks after the operation.

In Montgomery's case the so-called optic neuritis was probably early papillœdema due to the venous stasis. This view is borne out by his later reference to the presence of choked disk. The interesting feature is that the choked disk disappeared entirely following relief of the stasis, and although meningitis developed later, optic neuritis did not develop. This is evidence of the correctness of the view that the changes in the head of the nerve are due to venous stasis and are properly classified as choked disks even though the cavernous sinus is blocked by septic thrombosis.

In a discussion of this subject an otolaryngologist of prominence recently spoke of the difficulty he had encountered in obtaining from an ophthalmologic consultant a frank statement as to whether optic neuritis or choked disk was present in a certain case. He stated that the matter should be elucidated in this paper. Undoubtedly there is a great deal of confusion in the minds of many as to what constitutes choked disk, as it has come to be regarded in later years. Unfortunately, the two terms, optic neuritis and choked disk, have been used interchangeably in much of the older literature and are used interchangeably even today. The distinction is not a graphic one but I have seen it made confidently and accurately by young students after a few months of apprenticeship in ophthalmoscopy. One should not attempt to classify all œdematous and hæmorrhagic lesions of the head of the nerve into one or the other of these groups, particularly those in the long-standing cases or those in cases of apopletic type. Nor should one feel embarrassed in not being able to make the distinction, if in one's practice, as I know applies to many, such a condition is seen only at intervals of months or years. The differences to an experienced observer, however, are not hard to demonstrate in 95 per cent of the cases, and as the kind of treatment to be used may depend on proper interpretation of the ophthalmoscopic data, it becomes important to try to decide in all cases whether the disk shows neuritis or merely passive congestion with œdema. A clear-cut opinion usually is demanded by the neurologic surgeon or by the otolaryngologist if operation is to be recommended. This distinction probably is not so necessary in thrombosis of the cavernous sinus as in disease of the paranasal sinuses, brain abscess, or meningitis, since the surgical treatment of this condition is not so successful as medical treatment. Frequent examination of the fundus, with the ophthalmoscope, in a case of suspected thrombosis is of more value than a single examination or widely separated examinations. It would be well to follow the example of Patton who examined the fundus in his cases every 3 hours and noted the development of the venous engorgement and the progressive œdema of the disk.

THROMBOSIS OF LATERAL SINUSES

Phlebitis of the lateral and sigmoid sinuses is a common complication of suppurative disease of the mastoid process and gives rise to the graver symptoms of septicæmia that sometimes are encountered following operation on that region. However, the effect on the eyes, of the change in circulation, is not characteristic. Choked disk was found to be present in about 10 per cent of the cases reported by Tobey. He was never able to demonstrate, however, that pressure over one patent lateral

sinus, or over both simultaneously, made an appreciable difference in the eye grounds. Anatomically, the type of mastoid process apparently does not play an important part. Trible expressed the belief that ocular symptoms are usually those of toxæmia unless there is involvement of the cavernous sinus. Eves, in reporting his experience with 38 cases of lateral sinus thrombosis, wrote: "In about 10 per cent of the cases changes in the form of *optic neuritis* were seen by frequent examination of the eye grounds. This sign is of importance only when other causes of *intracranial pressure* are eliminated." Atkins studied 40 cases of lateral sinus thrombosis, and examined the fundus in 14 of them. In 4 cases there were beginning or well marked changes in the fundus before the operation on the sinus and in 13 there were marked changes after the operation. In one case, the fundi were normal 10 days after operation.

Choked disk may occur in cases of disease of the mastoid process without evidence of sinus thrombosis. Lillie and Lillie cited several reports from the literature and added 4 reports of cases from The Mayo Clinic. The 4 patients recovered completely. "There was no conclusive evidence of intradural extension, although it could not be definitely excluded. Three patients were found to show intracranial involvement in the form of a parasinus abscess; the others showed pachymeningitis and large cholesteostoma formation pressing on the sinus and cerebellum. One patient was subjected to intradural exploration without result."

With the knowledge that choked disk may occur in surgical disease of the mastoid process, with or without thrombosis of the lateral sinuses, the only conclusion one can reach regarding the significance of choked disk is that some intracranial involvement has taken place, but that the nature of this involvement is not manifest. Probably the gravity of the situation is heightened if choked disk follows frank, septic, sinus phlebitis. Such a conclusion cannot be proved from the few cases I have been able to review. It is suggested, however, by the following selected cases, taken from a group of 90 in H. I. Lillie's service at The Mayo Clinic.

REPORT OF CASES

CASE 1. A man had had discharge from both ears for 9 years. For a year before admission to the clinic he had suffered violent abdominal pains and shooting pains in the legs. For 2 months before admission, he had been quite ill. Appendectomy and cholecystectomy had been done for relief of pain, without encouraging result. On admission, he was ill with acute otitis media and mastoiditis of the right side. The pupils were small and could not be dilated with cocaine. The disks were hyperæmic, the margins blurred, the veins engorged; hæmorrhage and exudate were not present. The left disk was swollen more than the right, each less than 1 diopter. Complete mastoidectomy was done immediately. Two days later the swelling of the disks was as follows: right, 2 diopters; left, 3 diopters. For the next 5 or 6 days there was a septic type of temperature and considerable pain about the head. The disks were now swollen to the following degrees: right, 4 diopters; left, 3 diopters. The diagnosis of septic thrombosis was made. Ligation and incision of the right internal jugular vein, and ablation of the right lateral sinus, including the sigmoid portion, for thrombosis, were performed. Two days later the disks were swollen: the right to 3 diopters; the left to 3 diopters. Hæmorrhage and exudate were absent. The ocular movements were good; slight horizontal nystagmus was present; the visual fields were normal. The patient died 16 days after this operation. Necropsy revealed extension of the thrombosis from the ligated jugular vein to the superior vena cava.

The fundi of this patient were examined daily and the swelling was noted to be gradually increasing. Although there was temporary improvement in his condition following each operation it was not reflected in any change in the swelling of the disks.

CASE 2. A man, aged 55 years, came to the clinic with chronic otitis media on the right side, and acute mastoiditis. The diagnosis was of Bezold's abscess and lateral sinus phlebitis. Complete mastoidectomy was done on the right side. The lateral sinus was exposed, and at the knee a small region of phlebitis, involving one of the vasa vasorum was encountered. Two weeks later an abscess about the jugular bulb was drained. At a third operation, 2 weeks later, the jugular vein was ligated and the bulb ablated. The following day the patient died. The disks were acutely choked with retinal hæmorrhages at the last.

CASE 3. A girl, aged 5 years, was operated on for acute mastoiditis with thrombosis of the lateral sinus, involving its sigmoid portion. She recovered completely. Frequent ocular examinations gave entirely negative results.

CASE 4. A man, aged 22 years, had chronic otitis media and sinus thrombosis of the right side. At operation the vein in the neck was found to be collapsed below the level of the facial vein. Parasinus abscess was encountered over a large area; the outer wall was gangrenous and had sloughed. The sinus was ablated and the patient made an uneventful

recovery. The eyes were normal throughout the course.

CASE 5. A man, aged 22 years, had acute otitis media, parasinus abscess, and lateral sinus phlebitis of the right side. Complete mastoidectomy was done; the internal jugular vein was ligated and the sigmoid portion of the sinus was ablated. This was followed by recovery. Ocular examination gave negative results throughout.

CASE 6. A boy, aged 13 years, was subjected to complete mastoidectomy for subacute otitis media with lateral sinus phlebitis and general sepsis. The vein was not disturbed. Ocular examination gave negative results. Complete recovery ensued.

CASE 7. A woman, aged 22 years, had chronic otitis media, disease of the mastoid process, cholesteotoma, and parasinus abscess, including the sigmoid portion of the lateral sinus, all on the left side. She recovered following ablation of the sigmoid portion of the left lateral sinus and ligation of the left jugular vein. Ocular examination gave negative results.

CASE 8. A boy, aged 12 years, had acute unilateral mastoiditis and lateral sinus phlebitis. Because of bilateral chronic otitis media, double mastoidectomy was done, revealing unilateral sinus phlebitis. The sinus was not opened. Examination of the eyes gave negative results.

CASE 9. A boy, aged 4 years, was operated on in the emergency created by chronic otitis media, parasinus abscess, extradural abscess, and lateral sinus phlebitis, all of the left side. Complete mastoidectomy was done on the left side; the sinus was not opened. Five days later, signs of thrombosis led to a second operation. The left internal jugular vein was ligated and incised and the sigmoid portion of the left lateral sinus was ablated. Complete recovery followed. Ocular examination gave negative results.

CASE 10. A boy, aged 10 years, underwent unilateral mastoidectomy. This was followed in 2 weeks by a secondary operation. About two weeks afterward the jugular vein was ligated, and the sigmoid portion of the lateral sinus was ablated. Complete recovery ensued. Ocular examination gave negative results throughout.

VALUE OF EXAMINATION OF OCULAR FUNDI

Examination of the ocular fundi should be made on all patients with suppurative disease of the ear, although positive results will be obtained in only a small number of them. Sinus phlebitis is often a late complication of surgical disease of the mastoid process, and appears rather suddenly. Changes in the disks may precede changes in temperature and other signs of thrombosis. Choked disk is present in only about 10 to 20 per cent of cases of abscess of the brain but when it is present it is of considerable significance. If its value as a sign of intracranial involvement following septic sinus phlebitis is no more than it is in abscess of the brain, the fact that it is an index of serious extension of a pathological process makes it desirable. Progressive choked disk has been present in cases of sinus thrombosis observed at The Mayo Clinic only if the patients were extremely ill and went on to death. The value of choked disk as a diagnostic sign is reduced somewhat, unfortunately, by the fact that as the swelling increases the patient's condition is also noticeably worse. I believe, however, that patients who are equally ill, as judged by other signs, but who do not have choked disk, are more likely to recover. If this is true, it may be concluded that the appearance of progressive choked disk in a case of septic lateral sinus phlebitis is a sign of grave intracranial involvement. It occurs in less than 10 per cent of cases.

True optic neuritis I believe is a still rarer complication. A slight variation in the color of the disk, from what might be expected, is not to be interpreted as pathological, for there is no standard by which to judge, and variation in color of the disk and in the size and tortuosity of the retinal vessels may be very misleading, particularly if the patient is sick and if the examiner is anxious to find something of significance in the eye grounds.

LONGITUDINAL SINUS THROMBOSIS

Thrombosis of the longitudinal sinus is brought on by tumor or abscess of the brain or by extension of thrombosis from other sinuses. Often it is insidious in onset, or occurs in persons who are sick from extensive infection elsewhere. Therefore, the symptoms are masked and often unrecognized. Doyle, in 1926, reported 4 cases in which the condition had been found at necropsy and concluded: "In the absence of meningitis, the early onset of apathy or stupor in a patient with evidence of thrombosis of the lateral sinus secondary to suppurative otitis media generally indicates infectious thrombosis of the superior longitudinal sinus by retrograde extension, especially if associated with choked discs and convulsions."

Doyle found œdema of the eyelids and dilatation of the veins of the eyelids and forehead

in one case. Several other cases have been observed in The Mayo Clinic since the time of Doyle's report. Fifteen subjects who came to necropsy had been examined with the ophthalmoscope and the progress of lesions of the fundus had been noted. In 4 cases, the involvement of the longitudinal sinus followed suppurative disease of the ear, and other sinuses besides the longitudinal were involved. In 3 of these 4 cases ocular examination had been negative. In the fourth, cavernous sinus thrombosis was recognized by the swelling of the lids and by proptosis of the left eye, which was followed in 2 days by the same symptom involving the right eye. Dilatation of the veins of either eye was not present until after swelling and proptosis of the second eye were established.

One case followed a second operation for widespread infection of the frontal nasal accessory sinuses, with destruction of bone. Aside from œdema of the eyelids which accompanied the infection there were no ocular symptoms. The face, also, was œdematous. Choked disk was not present.

In one case of meningitis of unknown origin, in a baby, ocular signs were negative except for noticeable fullness of the retinal veins a few hours before death.

Two cases of unknown origin, which were recognized from the clinical symptoms, were seen late in the course of the disease. In one, thrombosis of the cavernous and longitudinal sinuses was found at necropsy; yet the only change noted in the eyes was marked contraction of the pupils. They responded quickly to the use of homatropine. In the other case there was left homonymous hemianopia, due to softening of the left side of the cerebrum which resulted from the thrombosis.

There were 7 cases of tumor of the brain in which thrombosis of the longitudinal sinus was found at necropsy. One patient, who had an infiltrating glioma, had vertical nystagmus a few weeks, but the fundi were negative to examination.

One patient, who had a pituitary tumor, had advanced optic atrophy; the fundus was otherwise negative to examination. The 5 remaining patients had choked disk, recorded as from 2 to 6 diopters, with changes in the visual fields and other visual disturbances that could well be accounted for on the basis of the tumor. In none of this group was there anything about the eyes to suggest thrombosis of the longitudinal sinus except the dilatation of the veins over the lids and forehead, as mentioned by Doyle, and this was noted in only one case. From observation of these 15 cases of proved thrombosis of the longitudinal sinus, it can be said that this condition does not cause characteristic changes about the eyes. In the absence of tumor of the brain or involvement of the cavernous sinus, choked disk has not been observed in this group of cases.

BIBLIOGRAPHY

1. Atkins, R. T. A report of forty cases of lateral sinus thrombosis. New York State J. Med., 1924, xxiv, 885–890.
2. Bowers, W. E. Two cases of cavernous sinus thrombosis associated with (1) acute purulent otitis media; (2) mastoiditis. Laryngoscope, 1927, xxxvii, 372–376.
3. Dixon, O. J. The pathologic examination in cavernous sinus thrombosis as a guide to the diagnosis, prognosis and treatment. J. Am. M. Ass., 1926, lxxxvii, 1088–1092.
4. Doyle, J. B. Obstruction of the longitudinal sinus. Arch. Neurol. & Psychiat., 1927, xviii, 374–382.
5. Eves, C. C. The diagnosis of lateral sinus thrombosis. Ann. Otol., Rhinol. & Laryngol., 1925, xxxiv, 1082–1088.
6. Lillie, H. I., and Lillie, W. I. Choked disks in association with surgical mastoid disease without apparent intradural involvement. Arch. Otolaryngol., 1925, ii, 355–361.
7. Montgomery, D. C. Cavernous sinus thrombosis: report of a case. South. M. J., 1926, xix, 566–570.
8. Parsons, J. H. Disease of the Eye. 6th ed., New York: The Macmillan Company, 1930.
9. Patton, J. M. Ocular involvement secondary to metastatic infection and cavernous sinus thrombosis. In: Contributions to Ophthalmic Science, pp. 179–189. Menasha, Wisconsin: George Banta Publishing Co., 1926.
10. de Schweinitz, G. E. Thrombosis of the cavernous sinus. Atlantic M. J., 1924, xxvii, 551–555.
11. Tobey, G. L., Jr. Differential diagnosis of lateral sinus thrombosis. Tr. Am. Acad. Ophth. & Oto-Laryngol., 1925, xxx, 26–37.
12. Trible, G. B. Sigmoid sinus thrombosis. Case reports. Laryngoscope, 1929, xxxix, 444–454.

DISCUSSION

Luther C. Peter, Philadelphia: I wish to call your attention to the fact that cavernous sinus thrombosis, when due to nasal origin, is a much more hopeful condition than when due to other causes. Eagleton reported that 24 per cent of his cases were of sinus and oral origin.

Several years ago, I reported recovery in three cases before The Ophthalmological Section of the College of Physicians in this city. In 2 cases the condition came from sphenoidal disease, and in 1 from a pneumococcic generalized infection of the blood stream. Since then, I have been fortunate enough to see two other cases of nasal origin which, also, recovered under energetic and prolonged treatment. This type of case is more insidious in its origin than are the cases due to other forms of infection. One symptom of cavernous sinus thrombosis, which was not discussed at length by Dr. Benedict, was that of œdema of the conjunctiva, which is particularly diagnostic and one of the first symptoms to appear.

Reference was made to enucleation. In the 5 cases, which have come to my attention in the last few years, enucleation was necessary in 2 cases. The necessity for the enucleation, however, must arise in the eyeball itself, and a perfectly normal eye or an eye which may recover should not be sacrificed unless it is desirable on the part of the neurosurgeon to approach the cavernous sinus through the orbit. This decision, and this latter operation, however, should be the prerogative of the neurosurgeon. Orbital approach to the cavernous sinus seems to be logical, but as one speaker has shown, exenteration of the orbit should be followed up by the opening up of the cavernous sinus with removal of the clot.

NEUROSURGICAL ASPECTS OF SINUS THROMBOSIS FROM THE STANDPOINT OF OPHTHALMOLOGY[1]

PROFESSOR DR. EMILE DE GRÓSZ, BUDAPEST, HUNGARY
Royal Hungarian University of Budapest

THE illustrious and famous neurologic surgeon, Harvey Cushing, made the following statement at the 13th International Ophthalmological Congress in Amsterdam: "The optic chiasm is the cross-road where ophthalmologists and neurologists had a common place of meeting and now that roentgenologists, endocrinologists, rhinologists and neurologic surgeons have begun to travel the same way, the need either of a traffic officer or a system of therapeutic stop and go signs begins to be apparent."

Kindly allow me, as a representative of ophthalmology—which is according to Harvey Cushing the oldest specialty—to be a traffic officer who would like to give a few indications to the most important work of the neurologic surgeon. I beg you to regard my effort with kind indulgence.

The first operation of penetrating the skull and of draining off fluid through the temple in order to save vision was carried out 2000 years ago. Nevertheless it was as late as 1860 that Albrecht Graefe first called attention to the unquestionable relation between choked disk and cerebral disturbances. Increasing intracranial pressure gives rise to œdema of the optic nerve, and accordingly choked disk is the most typical symptom associated with cerebral tumors involved with increased intracranial pressure. Gerstmann recently expressed his doubts at the Medical Society of Vienna as to the diagnostic importance of choked disk. Marburg, on the contrary, very justly pointed to the fact that choked disk is associated with 90 to 95 per cent of the cerebral tumors. For these reasons ophthalmoscopic examination is indispensable in cases suggesting cerebral tumors. If indisputable symptoms of choked disk be manifest they must be regarded as warnings of an approaching danger and indication for immediate action. Time must not be wasted with medicinal treatment or else the patient may soon develop complete loss of vision and become the victim of his original disease. The sooner the surgical intervention is performed the less chance of its mortality and the surer prospect of a permanent relief. Even in cases in which the original disease proves to be incurable it is a great benefit that vision is preserved for the rest of life, violent headaches and vomiting cease to torture the patient, and even life is prolonged somewhat. Horsley laid down these facts 40 years ago, and reported his special experience, which proved that choked disk may be cured even in cases in which the removal of cerebral tumor can not be attained. Thus a simple opening of the skull may stop the congestion, diminish the swelling of the papilla, and save vision. This fact gave impulse to the performance of palliative trephining. Hippel in Germany shared this view and emphasized the necessity of an early palliative trephining with the hope of preventing atrophy of the disk. I also began to support this idea of decompression 30 years ago. Harvey Cushing has made an immense contribution to the progress of neurologic surgery through his marvellous technical skill, through his great wisdom in selecting cases for operation, and through the careful pre-operative preparation of his patients. There is still, however, a great number of patients whose lives might have been saved or prolonged by means of a timely operation, and there are many who have lost vision in spite of the possibility of saving it for the rest of their lives. The possibility of localizing cerebral tumors is greatly helped by the development of methods of examination but the number of radical operations does not seem to keep pace with this development. The so-called "decompression" is so often carried out after such harmful delays that the resulting high death rate is apt to keep most surgeons from doing this operation.

This is especially true in Europe. All those familiar with the present subject are aware of the fact that the results obtained by European

[1]Presented before the Clinical Congress of the American College of Surgeons, Philadelphia, October 13-17, 1930.

surgeons are far behind the favorable results and great success achieved by Harvey Cushing.

Many factors have contributed to bring forth this state. It is of utmost importance that patients be operated on at a sufficiently early stage of the disease. Besides that there should be an ideal collaboration between neurologists, roentgenologists, and ophthalmologists and this has already been established in this country. Sauerbruch, the great German surgeon, shares the view that good equipment is of primary importance, and he attributes the better results obtained in Berlin as compared to those of Zurich and Munich to the careful preparation favored by conditions in Berlin. The following data throw even more light upon this question: 27,000 patients presented themselves for examination within one year at the I. University Eye Hospital of Budapest, under my direction. Twenty of them suffered from papillitis, 10 of whom complained of monocular, 10 of binocular defects. Only one of those patients was subjected to operative treatment. However, I recently observed, a young lady operated on by Prof. Hueltl 12 years ago. She then had a choked disk and on my advice underwent palliative trephining which resulted in the complete restoration of her vision, and she has had good health ever since. Professor Verebély performed only 30 decompressive trepanations within the last 10 years. Professor Pólya reports 70 patients within 15 years, but sight was already affected in the majority of his cases. Professor Hippel pointed to the fact for the last 30 years that vision is saved only if decompression be carried out while visual acuity is still intact, and the visual field has not suffered. Hippel recorded 166 cases, 54 of which had good vision, but in considering these results we have to take into account that operation was performed in most of cases at a later period. Olivecrona records 57 per cent mortality in 85 radical operations. Pascalis reports a death rate of 70 per cent in 101 radical operations. Krause found 36 per cent mortality in 109 cases. Kuettner's death rate was 30 per cent, Payr's 40 per cent.

Professor Ranzi of Innsbruck published remarkable results collected partly from the material of the University Hospital of Eiselsberg, partly at the Rudolf-Hospital in Vienna, and recently at the Surgical Hospital connected with the University of Innsbruck, within a period of 28 years. He recorded on the whole 354 neurosurgical cases. Under the radical operations 18 per cent to 68 per cent proved fatal, i. e., in 41 per cent. Among 154 cases of decompression Cushing's safety vent proved to have the lowest death-rate (13 per cent). This operation was performed 44 times and resulted in the prolongation of the life of 10 patients by 2 to 8 years. Twenty per cent of 111 patients survived successful palliative trephination for as long as 16 years.

There are several forms of decompression used, but the decompression of Harvey Cushing involves the least risk and is the most effective. The results of this operation surpass those of lumbar puncture, "Balkentisch" suboccipital puncture, opening of the optic canal, and incision into the optic sheath. It is obvious that surgeons endeavor to perform radical operations whenever the nature and seat of a tumor permits such interference. The rate of success following radical operations can be improved by the close collaboration of diverse specialists. The day has passed when the surgeon was not permitted to take part in consultations with physicians at the bed side and could only listen to the conclusions based upon the investigations of others. Today, on the other hand, the neurologic surgeon consults not only the physician, but the ophthalmologist, roentgenologist, and rhinologist.

In tumors situated in or above the sella turcica, the first complaint of patients is failure of vision. Thorough eye examination reveals the true diagnosis. The form vision may be unimpaired at the beginning but color-vision is apt to present a defect on the temporal side of the visual field. The diminishing of the field for color may forestall the constriction of the field by many years. Borel, of Switzerland, recorded very instructive cases. In one of his patients, a medical student, a diagnosis of neurasthenia was made by many competent specialists. However, he described his own bitemporal dyschromatopsia. Four years later it was proved he had hemiachromatopsia, 6 years later he showed symptoms

of a heteronymous bitemporal hemianopsia and 12 years later he died of a superpituitary glioma. Another case manifested amenorrhœa associated with bitemporal defect of the field for color. Death occurred 12 years later at the age of 40. Autopsy revealed a sarcoma situated above the pituitary gland. In the third case bitemporal dischromatopsia was followed 12 years later by hemianopsia, and death 20 years later was found to be due to a tumor. All these experiences point to the importance of the field for color and its special registration. Bitemporal heteronymous hemianopsia is pointing to the disturbance of the crossed bundle of the chiasm. Ophthalmoscopic findings may be normal at the beginning but a pallor of the papilla appears sooner or later and a typical picture of the simple optic nerve atrophy presents itself.

Roentgen examination proves to be of special assistance in the localization, as it throws light upon conditions existing in the sella turcica. A great number of tumors revealed by X-ray are operated on today. Hirsch records 169 operations and the mortality of the last 105 among these proved to be 5 per cent. Tumors extending to the sphenoid sinus and the cystic tumors are especially accessible while those adherent to the basis of the brain cannot be attacked by operation.

Harvey Cushing, the great master of neurologic surgery carried out 185 transfrontal operations within the 10 years. One group of these tumors is composed of craniopharyngiomata, the other of pituitary adenomata, and the third of meningiomata.

In addition to surgical intervention X-ray treatment is also gaining importance and considerable improvement has already been observed following these therapeutics. X-ray treatment may result in improvement in vision accompanied by the restoration of the visual field, and the progress of the disease may stop for several years. Passow and Stock attained considerable success by means of this treatment.

The next step in this field is to weigh and consider the different indications for operation, X-ray and medical treatment. The best results will be secured only with the close collaboration of competent specialists.

Harvey Cushing quotes the following advice given by Sir William Osler:

"The various organs, the diseases of which are subdivided for treatment, are not isolated, but complex parts of a complex whole, and every day's experience brings home the truth of the saying: 'when one member suffers, all the members suffer with it.' Further Plato put in the mouth of Socrates: 'I dare say you may have heard eminent physicians say to a patient who comes to them with bad eyes, that they cannot cure the eyes alone, but that if his eyes are to be cured, his head must be treated; and then again they say that to think of curing the head alone and not the rest of the body also, is the height of folly. And arguing in this way they apply their methods to the whole body, and try to treat and heal the whole and the part together.'"

The ophthalmologist is expected to take part in the preliminary considerations referring to the necessity of operative treatment; in other words it is his task to open the way to the surgeon.

Further, it is up to the surgeon's discretion what speed he should employ, and even his speed has to be controlled by the general physician.

The United States is at the front in the campaign put up for the sake of the highest law ruling our science, the *Salus Aegroti suprema Lex*, and the commander-in-chief is our most distinguished colleague, Harvey Cushing.

RHINOLOGICAL ASPECTS OF CAVERNOUS SINUS THROMBOSIS[1]

E. ROSS FAULKNER, M.D., NEW YORK

CAVERNOUS sinus thrombosis as a clinical entity has been recognized for nearly a hundred years; even before its clinical recognition it was described as a postmortem finding by Abercrombie[1].

The pathology of thrombosis in this region is the same as in other parts of the body, and both the aseptic and septic thrombus have been described. It is doubtful, however, if a true aseptic thrombus has ever been positively diagnosed clinically. Such a type of thrombus, as is well known, may occur in vessels like the femoral vein or in varicose veins anywhere and is due to a condition of the blood favored by a sluggish circulation. Theoretically, the trabeculæ in the cavernous sinus would favor such a formation, and it may be that some of the rare cases of unilateral exophthalmos which are puzzles in etiology are due to this cause. There is always a distal area in a septic thrombus which is aseptic, and if the infective agent is not of virulent type this portion may not break down. Such a thing may occur in the cavernous sinus even if the tributary veins contain a septic clot. This is the type of case which recovers after well marked symptoms of obstruction to the venous return have been present as a transient phenomenon.

The anatomical connections of the cavernous sinus are well known, and from such knowledge we can postulate the areas of local infection from which a thrombus may extend to the sinus. They may be classified according to the venous area of origin, though these areas overlap to some extent. Thus we have:

1. Anterior foci with infection spreading through the angular, supraorbital and supratrochlear veins to the ophthalmic veins.

2. Internal foci through the ethmoidal veins or spreading through the walls of the sphenoid sinus.

3. Inferior foci with spread of infection through the pterygoid plexus or by direct proximal infection of the internal jugular through lateral sinus and petrosals.

4. Posteriorly by extension from lateral sinus through the petrosals.

The three former routes come within the observation of the rhinologist while the last comes within the field of the otologist.

The anterior group of focal infections comprises such lesions as boils and carbuncles about the lip or ala nasi, and infection of the eye-lids. The writer has seen one case from infected herpes.

The internal group includes sinus infections: acute infections, usually supervening on an old chronic condition; after intranasal operation, such as an operation on the septum (2); and partial operations on the sinuses. In 1 case the condition occurred after partial removal of a middle turbinate.

The inferior group embraces: peritonsillar abscess; infection of operative field after tonsil operation; infections of superior maxilla, usually after extraction of teeth or primary osteomyelitis. Deep cervical abscess may infect the sinus through the pterygoid plexus or by infection of the jugular vein, thence through the lateral sinus and petrosals.

The incidence of involvement from these foci, from reported cases of various observers, seems fairly constant. Dorland Smith made an analysis of 140 cases giving the following ratio of origin: ear, 40 per cent; orbit and face, 35 per cent; mouth and throat, 13 per cent; nose, 9 per cent; other causes, 3 per cent.

The symptoms naturally vary somewhat according to the location of the primary focus. In the anterior group the local focus will be obvious and the first change will be an extension of the local boundary with brawniness and induration extending up the side of the nose or into the cheek. Pointing area of the focus will then usually be discharging a serous fluid rather than pus. Following this, with a short interval, swelling of eyelids will appear with chemosis and ophthalmos. Paralysis of the external rectus may appear early. There is not the marked local tenderness over the

[1]Presented before the Clinical Congress of the American College of Surgeons, Philadelphia, October 13–17, 1930.

supra-orbital ridge that is present in swelling of the lid from sinusitis. The local symptoms increase very rapidly. A chill, with temperature from 102 to 105 degrees may precede or follow the swelling of the lids. The temperature continues with slight remissions. Pain becomes severe as the meninges become involved and the case soon presents the picture of meningitis. An examination of the fundus in the early stages sometimes shows some fullness of the retinal veins, but this is not as constant as one would expect. Parsons estimates that this is present in about 20 per cent of cases. Swelling of the other eyelid with exophthalmos begins to appear before death and the superficial veins over the forehead may become dilated in the later stages. Cases in this group usually run a rapid fulminating course and death occurs before typical septic phenomena supervene. In the aural cases which are usually an extension from lateral sinus thrombosis the typical septic cycle may often occur.

In the cases arising from intranasal infection the local orbital symptoms will be about the same but may be very similar to symptoms produced by an extension of suppuration from ethmoids into the orbit. In severe cases the nasal membrane will appear very red and the discharge sanious rather than purulent. A sixth nerve paralysis may not be so significant as this can occur from a sphenoid without involvement of the cavernous sinus. Involvement of the third, fourth, and ophthalmic divisions of the fifth may occur as the disease progresses. Some of the more chronic types of cases can occur from extension through the walls of the sphenoid and recovery may occur in some of these cases after drainage of the original focus.

In the inferior group the local symptoms of a peritonsillar abscess or an infected tonsil fossa will be present with great swelling and œdema. In a deep cervical abscess there will be swelling back of the posterior pillar extending upward in the lateral wall of the nasopharynx. Septic phenomena may be an early symptom in such cases about the throat and neck due more probably to extension of the infective process to the jugular, as occurred in a case reported by Dr. Kernan.

The diagnosis of cavernous sinus thrombosis from the anterior infections is not usually difficult, but where the primary focus is in the intranasal sinuses the clinical picture of the sinusitis may quite obscure the thrombosis symptoms, and one may be in doubt for several days about the diagnosis. In looking over the literature one is inclined to believe that some of the reported cases of recovery were really an orbital abscess from a posterior ethmoid rupture which either drained itself into the posterior region of the nose or was relieved by an operation. Another doubt may arise as to whether there may not have been an actual thrombus present which gradually resolved after the original focus was removed. To illustrate the difficulty in differential diagnosis of these cases the writer recalls a case which was brought into the wards of the Manhattan Eye, Ear and Throat Hospital. When I saw him he presented a classical picture of cavernous sinus thrombosis and I demonstrated the case to house surgeons and students as very typical, noting especially the marked chemosis of the conjunctiva of the lower lid as being strong evidence of thrombosis, and also the absence of supra-orbital tenderness. The temperature was high and I expected the immediate onset of a meningitis. Patient had extensive intranasal sinus involvement but no discharge from the nose. After 3 days when the meningitis failed to appear I decided to operate by the Killian route. A large abscess was found in the orbit with necrotic ethmoids and a sphenoid full of pus. He made a good recovery and yet I thought at first that the diagnosis of sinus thrombosis was a certainty.

The chemosis of the lower lid is not pathognomonic of thrombosis, as I have seen it since from infra-orbital ethmoid infection and also from a severe antrum infection. Another case will illustrate what I think was an undoubted recovery from a cavernous sinus infection with beginning meningitis due to severe intranasal sinus infection. I saw the patient in consultation with Dr. Kelly. At the time he had great swelling of the eyelids with exophthalmos, and a positive Kernig and rigidity of the neck. Culture of spinal fluid showed a streptococcus. There was a very

severe sinusitis on the affected side. I gave a hopeless prognosis but advised opening up the sinuses by the Killian route. At the operation the ethmoids were found to be necrotic with pus in the orbit and pus under pressure in the sphenoid of the affected side. To our amazement the patient recovered.

Where there is doubt in distinguishing between a rupture of ethmoids into the orbit and cavernous sinus thrombosis secondary to the sinusitis, the matter will usually be definitely settled in 2 or 3 days. One can afford to wait in most of the sinus cases if any drainage can be established into the nose. Repeated shrinkings of the membrane and suction will help to accomplish this, and if one can wait until there is some localization of the infection any surgical procedure will be much safer. I have never seen a case develop a fatal sinus thrombosis from a delay in operating but I have known of many which developed a meningitis from early operative interference, probably from extension through the cavernous sinus.

Cases due to postoperative infection in the nose are quite rare and usually run a rapid fulminating course. The diagnosis presents little difficulty.

The group of cases due to infection in the throat and neck present the usual orbital symptoms but they run a rather longer clinical course. Some of these have an associated sphenoiditis or osteitis in the petrous portion of the temporal bone. These may show typical septic phenomena and suggest a doubt as to whether the jugular is not usually involved when such phenomena occur. The typical septic cycle with pyæmia is not likely to occur from a primary cavernous sinus alone. Its trabeculæ tend to hold the clot *in situ*, and it is only when the process has extended through the petrosals to the lateral sinus that such symptoms supervene. Most of them die of meningitis before this occurs. On the other hand, where the infection spreads from the jugular or lateral sinus the septic phenomena may be present for some time. That metastasis does occasionally occur even when the thrombosis is secondary to an anterior focus may be inferred from a case reported by Cabot in which a pneumonia developed.

The treatment of cavernous sinus thrombosis varies somewhat according to the location of the primary focus. In the anterior infections, if one could become suspicious of the complication sufficiently early, ligation of the angular vein might prevent it; but considering the great number of infections in this region which never develop any complication it would seem rather radical to tie the vein in all cases. When symptoms have appeared it is doubtful if ligation of the vein would do any good. There is one emphatic warning which should be given to all patients with even the slightest infection about the lip or side of the nose and that is to leave it alone. In all of these cases which I have observed there has been some tinkering with the original focus either with domestic or professional surgery. Even pressure to expel the secretion must be avoided. Hot fomentations at frequent intervals is the treatment most advisable for an infection in this region. In the intranasal cases with a definite orbital abscess this should be evacuated by the Killian route and the ethmoids exenterated. A sphenoid full of pus should be drained to relieve pressure. In the throat and neck cases, if a definite abscess can be located, it should be opened. In the streptococcal cases with no abscess formation surgery will accomplish nothing and may do harm. The direct attack on the sinus itself by the ultra radical surgical procedures either through the removal of the orbital contents or through the middle fossa route, has been tried, but as the anatomical structure of the sinus is such that no septic thrombus could be removed, one may reason *a priori* that no operation could accomplish very much, and reasoning *a posteri* there is very little evidence to warrant such a procedure. In reported cases of recovery where the eye has been removed one cannot but suspect that an equally good result could have been obtained by drainage of the orbit with removal of the ethmoids and orbital plate through the Killian incision.

The transfusion of blood from immunized donors has been recommended by Dr. Eagleton (3) and would be worth trying in any case. Ligation of the carotid on the affected side to put the part at rest has been tried but its value is not yet proved.

The percentage of recovery in all cases is very small but has been placed as high as 7 per cent in Dr. Darland Smith's series. The majority of these cases were of aural origin. There are few recoveries from the anterior infection though one is reported in Dr. Eagleton's (4) series. Recoveries in cases due to intranasal infection have been reported but are very rare and there is some suspicion that some may have been an orbital abscess. The throat and neck cases have the worst prognosis of all, especially if the thrombus extends through the pterygoid plexus. Cases with extension through the jugular offer some promise from early resection of the jugular and lateral sinus.

REFERENCES

1. Abercrombie. Diseases of the Brain, 1818.
2. Cabot. New England M. J., 1930, ccii, 381.
3. Eagleton. Cavernous Sinus Thrombosis, p. 168.
4. Ibid. Case G, p. 117.
5. Hays, Harold. Laryngoscope, 1909, Dec.
6. Kernan, John D. Cavernous sinus thrombosis secondary to peritonsillar abscess. Laryngoscope, 1921, xxxi.
7. Parsons. Pathology of the Eye, vol. iv.
8. Smith, Dorland. Cavernous sinus thrombosis with report of five cases. Arch. Ophth., 1918, xlvii, 482.

DISCUSSION

Prof. Dr. Emile de Grósz, Budapest, Hungary: Theoretically there is a twofold relationship between sinus thrombosis and affections of the eye. Either sinus thrombosis is the cause of secondary disturbances of the eye or a primary eye affection may produce the onset of a thrombosis of the cavernous sinus. In spite of those two possibilities this disease proves to be of extremely rare occurrence in our University Eye Hospital. The cerebral symptoms are usually so much more predominant in this disease that patients suffering from it are usually transferred to the medical or surgical wards, and so an opportunity is seldom afforded for prolonged observation, as early death is the most frequent outcome of the disease.

For these reasons among more than half a million patients who have appeared for examination at the I. University Eye Hospital of Budapest under my direction, we have observed but a few cavernous sinus thromboses cases within a period of 25 years.

On my inquiry I received the following reports from the leaders of the pathological-anatomical departments of the 4 Hungarian Universities. The autopsies performed within the last 10 years at the Pathological Anatomical Institute of Budapest did not reveal any sinus thrombosis due to orbital origin.

Identical reports were received from the Universities of Pécs and Szeged, while the report received from Debrecen is most remarkable as at their Pathological-Anatomical Institute they observed 4 cases of cavernous-sinus thrombosis within one year, in which a sty on the eye gave rise to this disease.

These cases are additional to those equally mortal ones recorded by Patton, in which thrombosis of the cavernous sinus was the sequence of a sty, and the case recorded by Mylius, in which the disease commenced with an acne on the eyelid, resulted in bilateral exophthalmus on the third day, and soon after resulted in death.

The frequency of such cases occurring in Debrecen suggests an extremely virulent pathogenic factor with which they must have been involved. This is the only plausible explanation for the fact that Dr. Sándor Nagy could have observed 4 cavernous sinus thromboses connected with eye disturbances within one year in Debrecen, which is more than I perceived on a much larger number of patients in Budapest during the last 25 years.

The eye symptoms of cavernous sinus thrombosis are very characteristic, especially those in septic thrombosis which often originate in the paranasal sinus or from the ear. It gives rise to exophthalmus, paralysis of the eye muscles, papillitis, neuritis, and, if occurring with bilateral involvement and attended with œdema of the mastoid, the diagnosis is obvious.

This centrifugal spreading of the disease may correspond to thrombophlebitis just as well as to congestion.

Sinus thrombosis following eye affections is produced by the extension of a thrombophlebitis of the veins. It may be brought about by a pimple on the eyelid or the nose, and the acute onset of exophthalmus is a warning sign pointing the dangers involved with it.

I transferred all my cases requiring orbital operations to professor Verebélÿ, and he found among 288 exophthalmus 76 that were due to inflammatory source and again among those 58 that were of pyogenic origin. Forty-seven cases of osteoperiostitis proved to be associated with empyema of the accessory sinuses.

My personal experience is small in number and that is due to my habit of passing on orbital operations to surgeons in general. I am convinced that a surgeon is more fit and skillful in operating on orbital tumors or phlegmons secondary to empyema of the paranasal sinuses.

Thus I have transferred a large number of orbital tumors to Prof. Verebélÿ, who has reported quite recently 288 cases.

My rôle on this ground is limited to that of a mere consultant surgeon.

Ralph Butler, M.D., F.A.C.S., Philadelphia: The lateral sinuses are involved most frequently in aural infections, next in order the cavernous sinuses and rarely the other large sinuses of the head. The petrosals are usually involved if the cavernous sinus is affected as the infection of the latter often takes place by a retrograde thrombosis of the former but sometimes the cavernous sinuses are infected from a

suppuration at the apex of the petrous pyramid. Statistics from 6 sources indicate that 4 per cent of suppurating mastoids are complicated by lateral sinus thrombosis. The cavernous sinuses are involved much less frequently. Jung reports 6 cases of primary jugular bulb infection out of 175 cases of sinus thrombosis.

Usually there is a purulent otitis media and mastoiditis. Occasionally the infection extends through the floor of the tympanum to the bulb of the jugular without clinical mastoiditis.

At times the diagnosis of lateral sinus thrombosis is made during the mastoid operation.

Although we may have phlebitis without fever, usually such symptoms as irregular fever, with or without chills, sweating, leucocytosis, and other general manifestations of sepsis are present suggesting involvement of a large vein and by exclusion, we limit the source to one or more of these sinuses. The presence of purulent otitis media naturaliy directs attention to the neighboring sinuses.

A number of years ago, two prominent internists had a case running a septic temperature for 2 weeks following the extraction of a tooth. All examinations were negative except that the X-ray showed a shadow in the left mastoid region. The appearance of the drumhead was negative and there was no history of ear trouble. An exploratory operation showed the mastoid cells to be necrotic and the sigmoid sinus thrombosed. The patient recovered after ligation of the jugular and removal of the clot.

About 3 weeks ago I lost a patient with lateral sinus thrombosis and meningitis who gave neither history nor evidence of purulent otitis media. The patient was an unusually intelligent woman and gave a reliable history. A few days before the operation there was no leucocytosis and the examination of the eyes was negative. She had slight bilateral middle ear deafness. We exposed the mastoid because of the persistent swelling of the external auditory canal, pain above the ear, and the suggestive X-ray findings in the mastoid. The mastoid was sclerosed and the sinus was bathed in pus and seemed to be pulsating normally.

Autopsy 2 days later showed a clot at the knee of the lateral sinus and a meningitis which was probably present for at least 2 days before the operation. This had been suspected but the signs were not sufficient to make a diagnosis.

One or more positive blood cultures, especially if the streptococcus is found, strengthens the diagnosis, but they may be negative with septic thrombosis. Other infections such as endocarditis may give positive blood cultures but these can usually be excluded by the internist. In late cases, metastasis may be present.

If the symptoms suggest a septic thrombosis and a diagnosis can not be made in any other way, the sinus should be uncovered and examined. The lateral sinus has a great advantage over the cavernous sinus in that it is easy of access and can be uncovered without much danger. However, before operating, it is better to wait long enough to eliminate the presence of other infections such as pneumonia, pyelitis and erysipelas. Such delays are not particularly dangerous because the symptoms at first are due to a phlebitis. Chronic purulent otitis media is not likely to develop a thrombosis without an acute exacerbation.

One must not be deceived by euphoria in these cases. It may mean good resistance but it by no means excludes a septic thrombus. I recall the case of a man with marked septic sinus thrombosis who refused to be admitted to the hospital because he felt so well between chills. Eventually he was cured by an operation on the sinus and ligation of the jugular but the delay was almost fatal.

It is often more difficult to diagnose cavernous than lateral sinus thrombosis and by the time the classical symptoms are developed, it is usually too late to save the patient by surgery.

The cavernous sinus may be filled with septic clot with high continuous temperature as the only symptom.

When we have symptoms of sepsis, the presence of a focus of infection in the ear is presumptive evidence that a large vein in that region is involved and this is usually the lateral but may be the cavernous sinus. The small cranial veins do not give positive blood cultures.

The prognosis for lateral sinus thrombosis is quite good if the patient is seen and diagnosis is made early. However, these patients may live a long time without operation. One of my patients could not be operated upon until he recovered sufficiently from pneumonia and empyema. Eventually he was cured by ligation of the jugular and removal of the clot.

About 7 per cent of the cases of cavernous sinus involvement recover spontaneously, as did one of mine which originated from a skin infection of the nasal bridge. Very few have recovered after operation on the sinus.

As in all collections of pus, the chief surgical indication is drainage. In lateral sinus cases usually the infection must be localized by ligation of the jugular which should be done before the clot is disturbed. Of course the source of the infection, the mastoid, should be operated upon but usually it is not necessary to resect the vein.

It requires unusual courage and confidence in the diagnosis of cavernous sinus thrombosis to remove an eye which may regain its function, or to go through the cranial cavity and open a large vein which may be full of blood. The disease is likely to be too far advanced before we decide to accept the operative risk.

Intravenous sterilization, serum and vaccine therapy, and blood transfusion are useful accessories after drainage.

Ligation of the carotid may be worth a trial but it is not without danger.

EDITORIALS

SURGERY, GYNECOLOGY AND OBSTETRICS

FRANKLIN H. MARTIN, M.D. ..... Managing Editor
ALLEN B. KANAVEL, M.D. ..... Associate Editor
LOYAL DAVIS, M.D. ..... Assistant Editor

WILLIAM J. MAYO, M.D. ..... Chief of Editorial Staff

FEBRUARY, 1931

THE SCIENTIFIC PROGRAMS OF THE TWENTIETH ANNUAL CLINICAL CONGRESS

THE papers presented at the scientific meetings of the Clinical Congress were of a high order and the subjects selected for the afternoon and evening meetings covered the newer phases of surgery of vital interest to practitioners.

The invited guests from foreign countries were men of distinction and truly representative of the best in surgery in their respective fields. American surgeons who contributed to the program were for the most part younger men who have gained distinction and succeeded to teaching positions in the outstanding medical schools of the United States and Canada. These men of a younger generation reflect the scientific spirit which dominates American medicine today and they are an inspiration to the young men just entering upon their surgical careers.

The John B. Murphy Oration by Professor George Grey Turner, of Newcastle-upon-Tyne, England, was fully up to the standard of previous orations on this occasion. The addresses of Mr. William Ernest Miles, of London, on "Cancer of the Rectum" were models of conciseness and scientific thoroughness. His precise diction and clean cut demonstration of the surgical treatment of rectal cancer left no doubt that he excels in this field. The addresses of Dr. Thierry de Martel, of Paris, Professor Otfrid Foerster, of Breslau, and Professor Henry Wade, of Edinburgh, were also masterpieces upon their subjects.

Special mention should be made of the Inaugural Address of Dr. C. Jeff Miller, on "The Humanities of Medicine" which was highly inspirational in character and sounded a note in keeping with the highest ideals of the medical profession.

The symposium on "Thoracic Surgery" was comprehensive and the speakers were young men who have had exceptional opportunities for practical experience in chest surgery. The symposium on "Electrosurgery" was timely and of especial value to the fellows at this stage of experimentation. With this new type of surgery Dr. Howard Kelly, in his characteristic manner, gave an exhaustive résumé of the new fields made amenable to surgery by electrosurgery. He was unqualifiedly enthusiastic. Sachs declared it to be a boon to the brain surgeon. Tinker commended it highly in thyroid surgery. Lilienthal believes that it has a definite place in lung surgery and in general surgery. Keyes, speaking of genito-urinary surgery, stated that he believed its usefulness was limited to bladder malignancy. On the whole, the opinion was favorable to this new agency.

The presentation of symposia in which the leaders in the various fields of surgery are

brought together for the discussion of the newer phases of their subject permit the presentation of the advances in scientific treatment and diagnosis. This is no better illustrated than in the symposia on surgery of the kidney, bladder, and ureters; treatment of burns, injuries, contractures, and congenital deformities; and the very excellent presentation of the subjects of traumatic surgery and cancer. Each of the papers was concise, and was presented in a skilful manner; and though intensely practical, they brought to the members of the Congress many new ideas and much inspiration.

CHARLES D. LOCKWOOD.

THE CLINICS OF THE CONGRESS

THE surgeons of the forty-three or more hospitals and clinics in and about Philadelphia presented to their visiting colleagues a well balanced and diversified clinical program. During the five days of the congress nearly two hundred and sixty operative clinics were held in general surgery, gynecology, and obstetrics, nearly thirty-five in surgery of the eye, and over one hundred in surgery of the ear, nose, and throat. Added to the operative clinics were numerous so-called dry clinics which comprised clinical case demonstrations, presentations of new procedures and technique, discussions of the results of clinical and experimental problems, finished and in progress, symposia on various aspects of clinical and operative surgery, and demonstrations from the pathological, roentgenological, and clinical laboratory.

A particularly pleasing part of the program has been the attempt on the part of a number of hospitals and university staffs to present an entire day's program of correlated material. Thus a morning spent in the operating room watching, let us say, operations in surgery of the chest, is followed by an afternoon in the amphitheater where the problems of chest surgery are discussed.

The clinical part of the program is particularly vital, for despite our constant turn to the laboratory for aid, the final testing ground is in the operating room and at the bedside. It is in the operating room and the ward that the surgeon visualizes the pathological anatomy and determines his course of treatment, and it is in the follow-up clinic that the wisdom of his course is determined.

The tremendous value of the clinics of the congress, forming as they do an accurate cross-sectional index to present day surgical practice, cannot be overestimated. A study of the program alone gives one a comprehensive grasp of the scope of modern surgery.

The doctors of Philadelphia, by their enthusiasm and co-operation have presented an unusually successful and excellently varied series of clinics, deeply appreciated and well attended by their professional colleagues.

MICHAEL L. MASON.

HOSPITAL STANDARDIZATION

THIRTEEN years ago Dr. Franklin H. Martin, Director-General of the American College of Surgeons, said: "There is nothing insurmountable, in my judgment, in the standardization of hospitals of this continent. It is a matter of organization. Standardization of hospitals can be accomplished only by firmness and by the untiring exercise of our convictions."

This prophetic statement has come true. The thirteenth annual Hospital Standardization Conference at Philadelphia, October 13-17, brought to a close the most successful year in the existence of the Department of Hospital Activities of the College. Reference to the conference program and the hospital

report for 1930 portrays the steady growth of the movement for better hospitals. The symposia consisted of topics on hospital administration, organization, professional service, education, and research; the sessions were attended by an enthusiastic and interested audience.

What is the significance of all this? The results of the hospital standardization program would seem to have exceeded the vision of the prophet. The standard of service in hospitals has not only been raised in accordance with the precepts of the Minimum Standard, but the public through its enlightenment has come to recognize its inherent right to efficient hospital and medical care. The people have become hospital conscious.

As a consequence, hospitals have accepted the challenge and responsibilities, and not only is this apparent among long established institutions but also in the new hospitals with their careers of service still before them. Today the new institution has the birthright of the Minimum Standard which in its development is to the hospital as the compass to the ship at sea. When we realize that there has been an increase of approximately 35,000 hospital beds during 1929 and that over 12,000,000 patients are treated annually in hospitals, does it not seem most fortunate that the Minimum Standard has been established for guidance of such institutions?

There can be no doubt of the increased efficiency of medicine, nursing, and other hospital services when one learns that the average days' stay of patients has, conservatively speaking, been cut in two during the past fifteen years. Concurrent with this, a similar reduction in hospital morbidities and mortalities has occurred. Nor has standardization overlooked the preventive side of medicine. It places the approved hospital, with its splendid equipment and personnel, in a strategic position to prevent disease by encouraging the family doctor in the use of the health inventorium for annual audits of his clients' health.

There is much to be done in improving institutions for the sick and the injured. But we can justly say that the greatest single force in the development of higher standards among hospitals is the standardization program of the College. And if the progress for the coming ten years equals that of the past decade, standardization can be credited with effecting a truly revolutionary improvement in hospital care, scientific medicine, and disease prevention E. W. WILLIAMSON.

THE CANCER PROGRAMS

CLINICAL research on cancer has engaged the attention of the College for the past ten years. This has been a co-operative research on the clinical phase of different kinds of cancer of different organs from various standpoints. The records on which these research studies have been based have been furnished by individual surgeons and hospitals throughout this continent. One of the by-products of these studies has been a considerable amount of information as to the character of the methods of diagnosis, therapy, and record-keeping in cancer cases throughout the country. Naturally imperfections in all of these have been found. It follows as a natural corollary from this that the College should interest itself in improving the care of the cancer patient through improvement in the diagnostic, therapeutic, and record-keeping methods throughout the country. Hence the Committee on the Treatment of Malignant Diseases has drawn up recommendations for the organization and administration of therapeutic and diagnostic cancer clinics in connection with general hospitals.[1]

[1] Surg., Gynec. & Obst., 1930, li, 570.

The first Round-Table Conference for the discussion of these subjects was held during this Clinical Congress. The program was furnished by men who are actively engaged in the war against cancer through their connection with existing cancer institutes, cancer hospitals, or cancer clinics. The audience consisted largely of men from all parts of the continent who had come to learn how to solve some of their problems encountered in an attempt to bring the best available medical knowledge to bear on their patients in the clinics that have been established or are in the process of being established. The verdict was unanimous that the program that was furnished accomplished the ends that were sought. Men left the Conference filled with better ideas as to how to meet their cancer problems and will carry the message to their associates. The result will be some degree of uniformity in the standard of excellence of cancer clinics throughout the country, and the College will continue to play its part in an advisory capacity, and in approval of those clinics which meet its standards.

At the Cancer Symposium papers of unusual interest were presented and are published elsewhere in this journal.

Cancer clinics at different Philadelphia hospitals added much of value to the general subject. BOWMAN C. CROWELL.

INDUSTRIAL MEDICINE AND TRAUMATIC SURGERY

THE discussions on industrial medicine and traumatic surgery and their correlated interests occupied an entire day at the Philadelphia meeting of the College; and the general reaction on the part of the Fellows and industrialists to this educational program was most gratifying and refreshing.

A considerable part of the time was devoted to the discussion of scientific subjects. A report of these is published elsewhere in this issue. It would appear that the plan of presenting some scientific papers conformed to the desires of the Fellows.

One presentation that was most favorably received emphasized the fact that in cases of highway accidents the hospitals and surgeons frequently are not paid, and it further offered a concrete proposal that an endeavor be made to secure changes in automobile liability insurance policies which would obviate this unfortunate situation.

The discussions on the part of the representatives of industry were most illuminating, instructive, and important. They showed an understanding and a comprehension of medicine and surgery as they apply to the relationships between employer and employee, and of the importance of the health of their organizations, that few medical men enjoy.

There is apparently an ever increasing interest being manifested by the medical profession in the questions involved in the social and political relationships of organized medicine. Some of these problems are the so-called contract practice, the high cost of being sick, hospital and health associations, health insurance, and others.

This is fortunate for leaders in industry are alive to the situation and are considering thoughtfully every phase of their responsibility to their employees in matters pertaining to their health.

Physicians and surgeons everywhere must develop a keen sense of the importance of their responsibility in preserving their established ethical attitude and influence in securing approved and scientific methods under their control for caring for the sick and injured.

It is interesting to record that at these joint meetings there is no evidence that industrialists or insurance companies have any

desire to bring about any form of paternalism or state medicine.

These subjects of industrial medicine and traumatic surgery are deserving of the widest surveys possible and a thoughtful and judicious consideration of all phases of the problems involved. All of the evidence, all of the information, and all of the knowledge that can be secured should be consolidated in an attempt to acquire sufficient wisdom and judgment to bring order out of the present involved and chaotic situation.

FREDERIC A. BESLEY.

EIGHTEENTH CONVOCATION

THE eighteenth convocation of the American College of Surgeons was held on the evening of October 17, 1930, in the ballroom of The Bellevue Stratford, Philadelphia. It was a fitting close to the successful five-day meeting of the Clinical Congress at which the major activities of the College were in evidence as never before.

Long in advance of the appointed time the balcony and available space on the main floor of the ballroom were completely filled with spectators. It was a solemn occasion for the initiates who by reason of superior training, constant application to duty, and conscientious personal effort were admitted as Fellows of the College.

To the strains of appropriate music the initiates and Fellows filed into the sections reserved for them. Then came a second group —the Governors of the College—who occupied the rear row of seats upon the platform.

Fanfare announced the entrance of the officers, officers-elect, and the Regents accompanied by the candidates for Honorary Fellowship and other distinguished guests from foreign countries. This latter procession had as an advance guard an officer of the U. S. Navy who bore aloft the Great Mace, that emblem of fellowship, sincerity, and dignity presented to the College by the Consulting Surgeons of the British armies.

The invocation was offered by the Reverend Doctor Floyd W. Tomkins.

The Director-General, Dr. Franklin H. Martin, presented the 659 (?) initiates, who repeated in unison the Fellowship pledge of the College, and were formally received into Fellowship by the President.

The candidates for Honorary Fellowship were as follows:

Professor Henry Wade, of Edinburgh, presented by Regent Richard R. Smith.

Professor Otfrid Foerster, of Breslau, presented by President-Elect Allen B. Kanavel.

Mr. William Ernest Miles, of London, presented by Vice-President Philip H. Kreuscher.

Professor Emile de Grosz, of Budapest, presented by Professor George E. deSchweinitz.

The Presidential Address by Dr. C. Jeff Miller on "The Doctors of Fiction" and the Fellowship Address by Dr. George W. Crile, chairman of the Board of Regents, on the "Obligations of the American College of Surgeons to Medicine and to the Public" will be published in detail in other pages of this volume.

Following the recessional an informal reception was given for the Fellows and guests by the officers and Regents of the College.

A new chapter has been written into the archives of the American College of Surgeons, a chapter replete with reports of achievements, epoch-making and filled with constructive suggestions for future activities. It will long stand as a landmark in the progress of medicine, and we will carry on with renewed ardor and enthusiasm toward that coveted goal of ever greater achievements in American surgery.

PHILIP H. KREUSCHER.

PRESIDENTIAL MEETING, CONVOCATION

ADDRESS OF WELCOME[1]

ELDRIDGE L. ELIASON, M.D., F.A C.S., PHILADELPHIA

AS chairman of the local Committee on Arrangements, it is part of my duty as well as my great privilege to welcome the College to Philadelphia. It is more or less fitting that this, the twentieth Congress, should be celebrated here, the birthplace as well as the generally acknowledged medical center of this country.

Philadelphia began entertaining us in 1911 and has been our hostess on an average of every 5 years since that date. A great many advances and many more opportunities for the improved care of patients, research activities, and teaching facilities, exist today as well as our ability to accommodate and entertain properly a greater number of you than was true even at the last Congress held here in 1925. Since that time many hundreds of hospital beds have been added to the old number. Such hospitals as the University of Pennsylvania, Jefferson, Methodist, Pennsylvania, Mt. Sinai, Germantown, Samaritan, and, last but not least of the larger hospitals, "Blockley"—the old poor house hospital, now known as the Philadelphia General Hospital—have erected many new buildings and acquired the last word in equipment for the care of patients. But last week only, the University of Pennsylvania staged a Celebration of the Advance in Medical Affairs of that Institution.

Furthermore, Philadelphia enjoys the distinction of fostering five qualified Class A Medical Schools, not including the Post Graduate School of Medicine of the University of Pennsylvania, with all the advantages to residents and visitors alike that such possession implies.

Your Committee on Arrangements recognizing these advancements and advantages is fully aware of its responsibilities and therefore has employed its utmost efforts to furnish us all with what we hope will be the greatest program ever offered to the American College of Surgeons.

The speakers, both foreign and domestic, for the presentations at headquarters have been chosen with the utmost care and the College is fortunate in having their acceptances.

Among the new features on the hospital clinical programs are a number of symposia on fractures, offered at five of the larger hospitals.

In closing, in behalf of the College, I wish to thank our Director General, his secretary, our local secretary, and our various Committees, as well as our hospitals, for the delightful way in which all have worked and planned for our entertainment.

[1]Read before the Clinical Congress of the American College of Surgeons, Philadelphia, October 13-17, 1930.

MILITARY OBLIGATIONS OF THE MEDICAL PROFESSION[1]

MAJOR GENERAL MERRITTE W. IRELAND, M.D., D.S.M., F.A.C.S., WASHINGTON

YOU are doubtless aware that this great honor of being the President of the American College of Surgeons has come to me not because of any eminence or skill in that branch of medicine, but because of my good fortune in having been for twelve years the Surgeon General of the Army. Also, I like to think that it is because I have, with many of you, that comradeship in military service in war which is one of the strongest and most enduring of the bonds of friendship. Therefore it seems to be fitting to occupy the few minutes that I shall take from the distinguished speakers that are to come, in speaking of the patriotic obligation of the members of our profession toward the national defense.

I take it for granted that we all as American citizens admit the obligation of service for the national defense, and for our profession the special duty to carry on the medical service of the armed forces afloat and ashore.

Military medicine, of course, includes most of the specialties of the medical practice of peace, excepting perhaps obstetrics and pediatrics, and laps most broadly perhaps into the domains of surgery, internal medicine, and preventive medicine. But even these acquire a special character from the emergencies of battle and the special and imperative conditions of war. In addition we have the administrative side of military medicine, which looms so large and appears often to be so vexatious and unreasonable to the newly commissioned medical officer. He has come into a new and strange world in which he is called upon to give up that individualism which is characteristic of our profession and find his place as a cog in a great machine. Also he finds that the medical service of which he has become a part is ancillary to the line of the Army or Navy, and in order to get along well with them he must learn their ways and rules and speak their language.

Now, it is to be noted that the specialty of military medicine, with its complex administrative problems and its special medical and surgical requirements, no longer interests the great body of the profession after a war is over. It is therefore quickly forgotten, and when another war comes our profession has to start all over again, and with much delay and confusion and lost motion receive a new education in military medicine. The question to be considered is how may this delay be avoided.

THE REVOLUTION

The solidarity of the profession in the recognition of this special duty to the country is rather a new development which has come about since medicine has, by its extraordinary advances in the last half century, become basically a science. In the Revolution, when medicine was not really on a scientific basis but was based on a great number of theories, many of which, although very ingenious, were not true, the profession was split up into a great number of schools of thought and theories of practice and there was no way in which it could be definitely organized for any purpose. One evidence of the hopeless futility of its methods when there was an effort to combine them into an effective organization was the fact that many of the outstanding men of our profession did not select to serve their country in the medical service, but sought line commands. Examples were Warren and Mercer, who were killed in battle, St. Clair, Dearborn, and others.

The Revolution lasted eight years, yet it cannot be said that an efficient medical service was evolved even so far as administration was concerned.

THE WAR OF 1812

In the war of 1812 the medical service shared with the line its lack of organization and its tragic inefficiency. The shortcomings of the former, however, have usually passed unnoticed in the dismal failures of our arms. As far as the land forces were concerned Victory smiled on our nation once at the end and brightened it with the single victory of New Orleans, which was, however, entirely barren of results because peace had already been declared. After this war the medical profession did not forget much because it had learned so little that there was not much to forget.

THE CIVIL WAR

The Civil War was long enough and hard fought enough to give time and opportunity for the development of some really great minds in military medicine. Surgeon General Hammond was a young man, and was pushed forward to the head of his Corps by the possession of really brilliant and original gifts. He selected another young man, Jonathan Letterman, to be chief surgeon of the army of the Potomac, and the latter developed a system for the rescue of the wounded in battle which was highly efficient and became ultimately

[1] Address of the Retiring President, presented before the Clinical Congress of the American College of Surgeons, Philadelphia, October 13-17, 1930.

the foundation from which the systems of other nations have been built up. The result was that by 1864 we had a really efficient and creditable medical service, one which, in the results accomplished, was probably as good as was possible in the state of professional knowledge at that time. You may be surprised to learn that neither of these able military surgeons, Hammond and Letterman, was in high favor in Washington. Hammond was driven ignominiously and, as we see it, most unjustly from the service, while Letterman shared the political discredit of his Commander, McClellan, and was ignored and practically forced to resign. It took over two years to develop an efficient service.

THE SPANISH-AMERICAN WAR

In the thirty years between the Civil War and our next military adventure, the Spanish-American War, the lessons of the former had been so thoroughly forgotten that even the older men in the medical corps who had taken part in it seemed to have lost, or were unable to apply, their experience. This was true by the time I entered the service in 1891. As this forgetfulness pervaded the Medical Department you may be sure that the ignorance of medical needs was still more dense in the War Department and in Congress. Although the Medical Corps was too small to look after the little army of twenty-five thousand men, and had to be helped out by the employment of civilian doctors under contract, the last action taken by Congress with reference to the Medical Department before we drifted into the Spanish-American War was to reduce the size of the Medical Corps.

REORGANIZATION

The war was too brief to develop any real efficiency in the medical or any other part of the army. The painful experience of this war did not teach the War Department anything so far as the Medical Department was concerned, for in the reorganization of 1901 it was left worse off than it was before. Out of this darkness, however, came light, for General O'Reilly appealed against what the Medical Corps called the "crime of 1901," and after a long fight of 4 years in which he was valiantly supported by the medical profession of the country, won from the War Department and from Congress an effective reorganization and the establishment of a Reserve Corps, which for the first time in our country enabled the Surgeon General to make intelligent and far-seeing preparations for war in time of peace. In the great gains of this period our sister medical service of the Navy has shared fully. The infinitely greater efficiency of the medical service in the World War than in former wars was due to these preparations, and was based largely on the organization of the Medical Reserve, and it in turn largely on the development of a spirit of unity and cohesion in our profession. This was made possible by the advance of medicine as a science, and by the rise and growth of the great American Medical Association.

THE WORLD WAR

Even to touch on the great accomplishment of our profession in the World War and the splendid work of so many Fellows of this College would take much longer than the time that I have allowed myself. I cannot, however, omit a passing reference to the Secretary and late President, and the originating genius of the College, Dr. Franklin H. Martin. His work as the only medical member of the Advisory Commission to the Council of National Defense, and as the organizer and chairman of the General Medical Board in April, 1917, makes him a star of the first magnitude in the receding horizon of the war. It was this General Medical Board (of which we have several members here tonight) that was the chief agency in the mobilization of the medical profession for the World War. But it took many months to do this, to expand our Reserve, to find out the qualifications and capacities of its members, and properly to locate the square and the round pegs. As it was, I cannot claim that we were one hundred per cent efficient in this peg game. Our valiant allies enabled us to devote a year to this, but we must do better than that in a future emergency.

THE MEDICAL RESERVE

All that is possible in the way of organization must be done in time of peace. My proposition to you is *to do it now*. The War Department plan is to do it largely through the Reserve. The War Department had been in the beginning so far from enthusiastic about the Medical Reserve that it took us several years of hard work to push it through. But though they did not have prevision they had vision, and by 1916 were converted to it, so that a reserve for all branches was the most important feature of the National Defense Act passed in June of that year. It is also the keystone of the plan of National Defense under which we are working today. As stated by General John McI. Palmer who was the original exponent of a peace-time organization of the Reserve "By this organization of the Reserve in which it is expected to enroll the Veterans of the World War it is proposed to perpetuate the framework of the organization developed in the World

War so that its tremendous cost can be funded as a permanent investment for all time." The medical profession have an important place in this plan, and we count on our medical veterans to make the first framework for the organization of the medical service.

The medical veterans should not only transmit their experience but set an example of service to the oncoming generation. We must have the younger generation in the Reserve, both to replace us veterans as we drop out of the cadres because of age or disability and moreover to complete our medical units which are at present far from full. We have at present eleven thousand commissioned Medical Reserve officers, and we need for the Medical Service of two Field Armies, according to the accepted and approved plan of the War Department, thirty-four thousand Medical Reserves. We hope to get these not only from the R.O.T.C. units but by bringing into the Reserve the other young medical graduates. It is in turning the minds of these young men toward their military obligation that you, the leaders of the profession to whom they look up, can both by precept and example perform a great patriotic service. This duty to serve in the Reserve and to assist it with your influence is your most important obligation, but it is not the sum total of it. In modern war the obligation of service and the capacity for it does not cease with the military age. Dr. Welch was sixty-seven when he first put on a military uniform. There is much valuable service that was done in the World War by our medical genro. A man is never too old to be a patriot and to do patriotic service of some sort.

I have in mind another agency for medical preparedness, an agency that is unofficial, but nonethe-less important. It is the Association of Military Surgeons of the United States. It is the oldest of like organizations, having been founded in 1892 by the great surgeon, Nicholas Senn. Its publication, *The Military Surgeon*, is the only magazine in this country devoted to military medicine, and to maintaining an up-to-date knowledge of this specialty, which, as I have already said, we are prone to forget in time of peace. The influence of this Association in bringing together and co-ordinating from a military point of view the Government Medical Services, the National Guard, and the Medical Reserve of the Army and Navy is most valuable. It is the only agency through which they are all brought in contact with each other. It is also the only agency through which we are brought into contact with the medical services of the armies and navies of other nations. This is done by inviting them to send delegates to the annual meetings of the Association, and by its being represented by delegates at the Biennial International Congresses of Military Medicine and Pharmacy at which all great nations are represented. The full reports of these congresses have from the beginning been published in *The Military Surgeon*, and are thus made accessible to all members of the Association. I have no hesitation in stating my opinion that the support of this Association is of great importance to medical preparedness, and is a part of the military obligation of every man of our profession who is eligible to membership, and that this obligation does not cease with old age or physical disability, but is co-terminous with our American citizenship.

THE HUMANITIES OF MEDICINE[1]

C. JEFF MILLER, M.D., F.A.C.S., NEW ORLEANS, LOUISIANA

AN old legend tells us that many years ago, when Rome was mistress of the world, all of her captive peoples were granted one night in the year on which they might say exactly what they wished about everything—of course including Rome—without fear of consequences. The story ends there, but I have always had an idea that it was unfinished. I am sure it must go on, to the effect that each year, when the night for speaking rolled around, there was little talking done, for it is the way of the world that "the magic of the necessary word" should be lacking when the need for it is the greatest.

My need for it is very great tonight, Gentlemen of the College of Surgeons, and yet I lack it utterly. You must therefore comprehend my appreciation, even though it is unspoken, you must accept, as if it had been uttered, my gratitude that your gracious mandate has placed me in this honorable position, doubly honorable because of the men who have preceded me in it. I occupy it through no merit of my own, but simply as the representative of the surgeons of the South, whom I know it was in your hearts to honor.

I am sure that each of the distinguished line of its presidents must have felt as I do, at once proud and humble, as he stood before this great assembly of the American College of Surgeons and realized again the high purposes for which this organization came into being. Its achievements in the past, its hopes for the future you know so well that I need not recount them to you, but one thing I would say: that there should never be a Congress of the College at which tribute is not paid to the man who conceived its existence, under whose direction and inspiration its work has been done, who has served it without ceasing since the day of its inception, who will continue to serve it, we hope and believe, for long years to come. To Franklin H. Martin is owed the everlasting gratitude of the surgeons of America, and in this mighty organization he has builded for himself a monument *ære perennius*, more lasting than bronze.

I shall ask you to bear with me tonight while I speak to you on a subject that is not new but that can never be truly old. I hope you will remember what Dr. DaCosta has very wisely said, that the repetition of the same ideas does not of necessity indicate paucity of thought, that it may equally well indicate depth of conviction. I have chosen to speak to you of something that is all too often forgotten, and that, for lack of a better name, I have called "the humanities of medicine."

Perhaps the most characteristic aspect of American civilization today is the trend toward standardization, and American medicine has become infected with the same virus. We have standardized our hospitals and our medical schools, and our patients are in all respects the better for it. We have standardized our laboratory methods and our medical and surgical therapeutics, and our patients are in many respects the better for it. But we are in very great danger—I do not use the word lightly—of standardizing ourselves and them, and we are both the worse for it. There is a limit to the advantages of standardization, and I greatly fear that we have reached it. I know that it would profit us and I am sure that it would not lessen our scientific efficiency to be more personal and more human in our relationships, to regard as something more than cases and symptom complexes the ailing men and women who turn to us for aid.

For the care of the sick implies more than the use of the knife, the prescription of drugs, the employment of systems of therapeutics. The practice of medicine implies more than the application of medical science. Call it what you will, there is another aspect of the practice of medicine which you cannot get away from. There is a relationship between doctor and patient which cannot be charted and diagrammed. It awakens sympathy and kindliness and pitifulness on the part of the one, and it inevitably begets faith and hope and trust in the other. It is not inconsistent with accurate diagnosis and scientific treatment. It is the complement of them, and it is quite as essential as they are.

Our forefathers had it in full measure, perhaps because the limitations of the age made their scientific knowledge and their technical skill insufficient in themselves. We of the middle generation—I say it without sense of complacency for our shortcomings are many—are not altogether without it for somewhat the same reason, that our medical upbringing had more to do with the patient and less to do with the laboratory than has the medical training of this year of

[1]Inaugural Address, Clinical Congress of the American College of Surgeons, Philadelphia, October 13-17, 1930.

C. Jeff Miller

grace. But the younger generation possesses it in less and less degree, because the modern medical student—I crave your indulgence for trespassing on this timeworn theme—is turned out on the world excellently versed in all the medical sciences, considerably less versed in the medical arts, and totally unversed in the treatment of patients as anything but cases to be handled by rule of thumb.

And ailing humanity cannot be so handled. Body and soul cannot be separated for purposes of treatment, for they are one and indivisible. Sick minds must be healed as well as sick bodies. Whether he will or no, the doctor's office is very often a confessional of spiritual as well as of physical disability. Mankind's eternal cry is for release, and the physician must answer it with something more than a test tube, something beyond faultless technique. The cure—which really means the care—of the sick, the relief of suffering, the salvation of life, these are the high aims of the medical profession, as they were the high aims of the priesthood from which it sprung, and scientific knowledge and medical skill will not of themselves bring them to pass.

Many years ago a speaker before an assembly such as this, remembering the tale of Hezekiah and the cure of his grievous illness, suggested that the seal of the American College of Surgeons might well be a sun dial whose shadow was forever halted and turned back by the merciful hand of the surgeon. Not always, Gentlemen, it is not always halted and turned back. Too often it continues on its way. And yet how many of us, untouched by its solemn mysteries, are so coolly scientific, so detached, so impersonal, so almost unhuman, that, consciously or unconsciously, we try to standardize death itself. We deal with tremendous forces in our daily work. We take the issues of human life into our keeping when we lay hands on the human body, and only too often we take them with a carelessness and a lighthearted indifference that is wholly unbecoming and unworthy.

The surgeon above all other physicians needs fortitude for his task. He must steel himself against giving way to emotion that his usefulness be not lessened, but it does not follow that he must not feel it. Like DaCosta, I should not wish "a man who does not care a whole lot" to operate on me or mine. The surgeon cannot afford to nurse his regrets, but no more can he afford not to have them. As Darrach puts it, he must from his losses learn his lesson without losing his courage. And the older he is, the more knowledge he possesses, the greater is his anxiety, the deeper is his comprehension of what weighty issues hang upon his every decision and his every act. In the bitterness of regret for a lost life there is only too often the bitterer realization that an error in judgment, a slip of the hand, has turned the scale and lost the fight. It is small comfort to realize also that no matter how skilful and careful and conscientious he may be, he is but human, and the fact that he is introduces not only the possibility of error but the certainty of it.

But if it is wrong to brood upon this aspect of surgery, it is equally wrong not to dwell upon it at all, to clothe ourselves in a mask of indifference, to steel ourselves against all feeling. We are too busy, too careless, too uncaring, to remember what we know full well, that the decisions we pronounce so casually may mean the difference between hope and despair, between release and anguish, between life and death, to the men and women who have entrusted their fate to us. A great British surgeon, who is not too scientific to be sensible—I use that word in its original signification—bids us never to forget as we practice our profession that what to us is an incident in our daily life is to our patients an ordeal, perhaps the mightiest they shall ever be called upon to endure. We need to be merciless in order to be merciful, we need to be pitiless in order to be pitiful, but not to the patient, only to his disease. We are recreant to our trust, we are unmindful of our high calling, if we treat the one with the sternness with which we must treat the other.

Stephen Paget, kindliest of philosophers, says that practice is science, but science touched with emotion, and that the best physician is he who leaves behind him a saucerful of the milk of human kindness for gossip to lap. It is not very often left behind, I fear, even by those of us who honestly strive to give of our best to our patients. And yet one of the greatest physicians who ever lived, as distinguished for his beautiful courtesy as for his surpassing scientific skill, did not think it belittling to give it in full measure. Sir William Osler, it was said, never left a sickroom without leaving renewed hope behind him, and it was his kindliness as much as his therapeutics that wrought the benediction of healing. If you will read for yourselves the record of his life, written with loving simplicity by Harvey Cushing, a former president of this College and himself as much a master of the surgical art as of the written word, I need labor my theme no longer: in the pages of that book is painted the perfect combination of scientist and humanist for which I have been pleading.

We who are admitted to the Fellowship of this College know that the chief reason for its existence is the improvement of the practice of surgery. We know that the chief concern of the surgical art is the healing of the sick. And I have chosen to address you tonight on the humanities of medicine—which I hope does not seem to you a trivial theme—because I greatly fear that this organization, as others like it have done, in its very zeal for the welfare of the sick, in its very eagerness for the relief of suffering, is in danger of over-reaching itself, is in danger of forgetting that it takes more than a machine, however perfect the mechanism may be, to translate visions and to bring dreams to pass. Men and women in "trouble, sorrow, need, sickness, or any other adversity" are still crying the age-old cry, "Is there no Balm in Gilead, is there no physician there?" and men, not machines, must answer their call.

No amount of scientific efficiency can take the place of kindliness and pitifulness when the darker hours come on, and we enrich ourselves by giving of them freely. In these intangible things, in President Eliot's fine phrase, are found "the durable satisfactions of life," for "fame dies and honors perish, but loving-kindness is immortal."

PRESENTATION OF HONORARY FELLOWS

FRANKLIN H. MARTIN, M.D., F.A.C.S., CHICAGO

AT the Convocation on Friday evening honorary fellowships were conferred by the President on the following eminent surgeons.

PROFESSOR HENRY WADE, C.M.G., D.S.O., F.R.C.S., Edinburgh, Scotland, Eminent Surgeon and Urologist; Bachelor of Surgery; Doctor of Medicine; Fellow of the Royal College of Surgeons of Edinburgh; Graduate in Medicine and Senior Lecturer in Clinical Surgery, University of Edinburgh; Lecturer in Clinical Surgery, School of Medicine of the Royal College of Surgeons of Edinburgh; and Surgeon to the Royal Infirmary. Introduced by Richard R. Smith, regent.

PROFESSOR OTFRID FOERSTER, Breslau, Germany, Distinguished Neurologist; Graduate in Medicine and Professor of Neurology in the University of Breslau; Chief Physician of the Neurologic Department of the Wentzel-Hancke Krankenhaus of the city of Breslau. Introduced by President-Elect Allen B. Kanavel.

WILLIAM ERNEST MILES, F.R.C.S., London, England, Graduate in Medicine from St. Bartholomew's Hospital and College; Fellow of the Royal College of Surgeons of England; Surgeon Emeritus to the Cancer Hospital, London; Member of Grand Council and of the Executive Committee of the British Empire Cancer Campaign; Member of the Radium Commission of London; Surgeon, Gordon Hospital for Diseases of the Rectum, London; Consulting Surgeon, Royal Hospital, Richmond; and distinguished author. Introduced by Vice-President Philip H. Kreuscher.

PROFESSOR DOCTOR EMILE DE GRÓSZ, Budapest, Hungary, Eminent Ophthalmologist; Graduate in Medicine and Professor in Ordinary at the Royal Hungarian University of Budapest; Director of the Eye Hospital; Royal Hungarian Court Councillor; President of the International Organization for Campaign against Trachoma, and of the Post-Graduate Committee in Hungary. Introduced by Professor George E. deSchweinitz.

PRESENTATION OF CANDIDATES

FRANKLIN H. MARTIN, M.D., F.A.C.S., CHICAGO

EACH year as we receive a new class of candidates into Fellowship I am impressed by the prestige of an institution that can influence such a goodly number of busy practitioners of surgery to seek its portals.

To the casual observer these men appear as one more group that is being enrolled into our ranks. Complacently, this observer shrugs his shoulders and reflects: "How easy!"

As an illustration, let us tell you the facts:

There were 4,255 applications for Fellowship in file January 1, 1930; 701 of them were already approved by their State or Provincial Committee on Credentials; 1,475 were presented to State and Provincial Committees on Credentials during this year. Of these, only 672, or 45.6 per cent, were approved and recommended for examination. Of the total recommended for Fellowship before and since January 1, 1930 (1,373), our careful sifting process has admitted to Fellowship only 654, or 47.6 per cent, constituting the candidates who are here present.

Surely if we pay tribute where tribute is due we must pay full portion to the magnificent group which is before us this evening. Veritably they are the survival of the fittest.

They are to be congratulated; and the *College* is to be congratulated; but above all, we must congratulate the people who shall in the future seek their services.

CASE RECORDS

Honor List and Prize Award

SURGERY, GYNECOLOGY AND OBSTETRICS—the official journal of the American College of Surgeons—acknowledges a deep obligation to the latter organization. Two of the fundamental activities of the College have materially increased the value of contributions to medical and surgical literature: First, the standardization and amplification of case records in the approved hospitals of the United States and Canada; and, second, the regulation of the College which requires as an evidence of qualification for Fellowship the filing of

one hundred case records of operations actually performed by the candidate.

I wish every friend of the College could peruse the sixty thousand individual case records filed this year by this group of successful candidates here before us. And the judicial and painstaking examination of those sixty thousand records by the group of volunteers, who are selected from among the teachers of surgery and the specialties in the medical departments of the four universities of Chicago would be an inspiration to any observer. Each year the quality of these records has improved until now, after 17 years of effort, many of them are veritable volumes of literature of the most acceptable type—mechanically, artistically, and scientifically.

SURGERY, GYNECOLOGY AND OBSTETRICS asked the privilege (and the request was cheerfully granted by the Regents) of presenting an annual prize in the form of a life Fellowship in the American College of Surgeons for the most acceptable set of case records presented by the candidates during the preceding year. The prize consists of Five Hundred Dollars, invested in the name of the successful candidate for life dues in the American College of Surgeons, and is accompanied by an appropriately engraved certificate of appreciation on behalf of the donor, SURGERY, GYNECOLOGY AND OBSTETRICS.

Mr. President—The Committee in seeking the prize winner from among the successful candidates before you, selected five outstanding sets of records which constitute an honor list. May I ask each honor man to rise as his name is read?

Theodore L. Hansen, of Chicago, Illinois
Frederick A. Reuter, of Washington, D. C.
Thomas B. Murphy, of Medford, Massachusetts
R. W. McKay, of Charlotte, North Carolina
James Thomas Nix, Jr., of New Orleans, Louisiana.

And now, Mr. President, may I announce the prize winner from among this group, and invite him to the platform to receive from your hand the Certificate of Appreciation from our official journal, and the formal receipt for life dues in the American College of Surgeons. The prize winner is:

Dr. James Thomas Nix, Jr., of New Orleans, Louisiana.

CLASS OF 1930

United States	630
Canada	20
Hawaii	2
Mexico	1
South America	1
Total	654

THE DOCTORS OF FICTION[1]

C. JEFF MILLER, M.D., F.A.C.S., NEW ORLEANS

IT would be a work of supererogation, Gentlemen of the College of Surgeons, for me to repeat at this Convocation the things which have been so ably said at other Convocations by my predecessors in this high office. It is quite unnecessary for me to recount to you the ideals and achievements of this organization, for you know them as well as I. It is equally unnecessary for me to urge the newly admitted Fellows of the College to bear those ideals always in mind throughout their professional lives; the fact of their application for Fellowship is sufficient evidence of their desire and endeavor to be guided by them. And so I shall pass over these themes, and in the time at my disposal tonight I shall ask you to consider with me a subject which is far from scientific, yet which I think cannot fail to be of interest to physicians, and to the friends of physicians whom we gladly welcome to this assembly, the subject of the doctor as he is conceived by the novelist.

Five or six years ago a writer of no mean ability, the son of a physician, I believe, in the course of a series of criticisms directed at various aspects of American civilization, paid his respects to the medical profession in a book called *Arrowsmith*. It is, as you know, the story of a vulgar, cynical, disappointed, altogether unworthy young doctor who finally, after various unsuccessful attempts at various branches of medicine, retires to the New England woods, where, so we are led to believe, he is to save his soul by devotion to pure science. Just why he should acquire merit by that particular performance is not quite clear. Those of you who have read the book will probably agree with me that it is very doubtful whether a person of his essential defects of character is likely to win salvation anywhere. Certainly there is nothing in the New England woods, or in pure science either, which can of itself cleanse and purify a person of fundamental unworthiness.

Now this protagonist, who is anything but a hero himself, is surrounded by a group of physicians of his own kind. In the dozens of doctors who crowd the pages of the book there is scarcely one who is not a hypocrite, a scoundrel, a vulgarian, an ignoramus, or worse. There is scarcely one who does not debase his profession and himself. All the grossness of medical life, all the littleness and meanness of college and hospital and profession—and no one denies that they do exist—are depicted with a harsh vindictiveness that overreaches itself and is as unconvincing as it is in the similar studies of Bernard Shaw, Maarten Maartens, and Robert Herrick. This group of authors, you will recall, labors under the conviction that to earn one's bread by the healing of the sick is to sell one's soul for hire; it believes that only by a return to nature and by state control of medicine can the purging of the profession be achieved.

As a matter of fact, *Arrowsmith* and other books like it are no more a picture of medical life than *What Price Glory* is a picture of the War. There are unworthy men in the ranks of medicine, just as there are in the ranks of the Army, but surely they are not all gathered together into one spot. There are also worthy men. Dramatic heightening is a legitimate literary device, but when one undertakes to present a cross section of life, an obligation rests upon one to be honorable about it, and it seems reasonable to assume that amid so many, some few must be at least gentlemen. Yet no one, reading *Arrowsmith* and its like, would think that honor and decency, courtesy and kindness, self-sacrifice and courage, existed among physicians, as they do in full measure.

It is a curious thing that so few novels in which doctors appear present them as they really are, for surely no profession offers the novelist more material in the way of tragedy or comedy, or in the lights and shadows of life. In many novels physicians are little more than lay figures. They are labelled "M.D.," as Weir Mitchell points out, and they are frequently very pleasant people, but they have none of the characteristics of their profession, and they might equally well be lawyers or manufacturers or business men. Even the ambulance surgeons, who arrive with verve and dash and at exactly the right moment, are a colorless crew, and as for the coroners and their assistants—whose name is legion in this day of countless detective stories—most of them are egregious asses.

I have a distinct aversion to a certain group of physicians of fiction, perhaps because I have such an antipathy to their prototypes whom I number among my acquaintances. Their profession is written all over them, and they are persons of tremendous responsibilities. In fact, they never

[1]Presidential Address delivered at the Convocation of the American College of Surgeons, Philadelphia, October 17, 1930

do anything simple. They perform operations of the utmost gravity, preferably on their lifelong enemies, in which they acquire septicæmia or something similar, and generally perish of it, though the said enemy always recovers. They remove portions of the human anatomy—frequently those which are anatomically impossible of removal—just before it is too late. They staunch hæmorrhages which would have ended fatally in a split second more. They assume charge in epidemics of cholera and yellow fever, and they meet grave emergencies in countless numbers and always with unrivalled skill and wisdom. But they never by any chance take care of trivial ailments, for the characters of novels would never by any chance so far forget themselves as to have trivial ailments.

The obstetricians of this group annoy me most profoundly. As a former practitioner of that specialty I know, romancers to the contrary, that the occasions are extremely few on which one emerges from the parturient chamber, pale with anxiety and covered with blood, to gasp in trembling tones to the anguished husband, who is equally pale but minus the blood, that it is a question of the mother's life or the child's. I likewise know that when such occasions are met with in real life, far from being romantic, they are merely unmistakable evidence that somebody has been very incompetent indeed.

Finally, there is the group of physicians who are simply too good to be true. These paragons are as unlike human beings in their virtues as Arrowsmith and his associates are in their vices. They are more than sweet, they are saccharine, and one turns from them surfeited with goodness and secretly longing for a little wholesome badness.

I digress to remark that one could scarcely expect realistic physicians to walk the wards of the hospitals of the average novelist's imagination. If such institutions really existed, with their informal management and total lack of discipline, especially among the nursing staff, the death rate in them would be beyond all bounds. It has always been a source of wonder to me that a woman, herself a nurse, could perpetrate a story with as many glaring inaccuracies as Mrs. Rinehart has achieved in *K*, though I grant you that one must be stony-hearted indeed to pick flaws in her spotless hero and his impossible predicament.

The first physician who crosses the pages of English literature appears not in a novel, but in one of the great poems of the world. I have in mind that Doctor of Physick who made his way with the other Canterbury Pilgrims across England from the Tabard Inn that sweet April morning nearly six hundred years ago. He was a proper man, almost a prelate in the eyes of mine Host Bailly. Indeed, that gentleman was so overcome by the tragic story he told that he must demand at once a merry tale from the Pardoner, lest his sadness overcome him and he need the physician's drugs to set him up in health again. The Physician's personal appearance must have been exquisite, for he was clad in fine silken garments of red and blue. And his skill must have been superhuman, for he knew the causes of all illnesses and could heal them all by natural magic and the Bible, as well as by the aid of astronomy, in which he was so well versed that he could tell his patient's prospects from the stars. Withal, he and the Apothecary understood each other from the beginning, and one wonders, though perhaps the thought is unworthy, how much this friendship had to do with the gold which the Physician had won in the plague years and upon whose safekeeping he set so much store.

Four centuries later Smollett, one of the first English novelists and himself a physician of sorts, put many physicians into his books, but they are a sorry group, and one almost wishes that he had not described them so vividly as they buy and sell their patients, as they ply for trade like the scullers at Hungerford Stairs, and as they debase their profession to their own unworthy ends. Ignorant, coarse, and cruel, they may be lifelike, indeed they are undoubtedly representative of the doctors of the day, but as Mr. Mantilini would say, they are "demnition unpleasant."

A more agreeable eighteenth century physician is the famous Dr. Slop, "the scientific operator," who manages to get Tristram Shandy into the world, albeit with a broken nose, after one hundred pages of travail. Mrs. Shandy, you will remember, was most anxious to be delivered of her child by a midwife, particularly as the said lady was in need of "a friendly lift;" having been left a widow at forty-seven, with three or four small children, she elected midwifery as her career, on the principle, still in vogue, of personal necessity rather than personal fitness. But Dr. Slop, in spite of her pathetic situation, gets the case, and he appears on the scene with his squat figure and sesquipedalian belly, but minus his obstetric equipment, which, unlike many zealous accoucheurs of this modern age, he has left at home. While the instruments of salvation and deliverance are being fetched, he enters into

conversation with Mrs. Shandy, pointing out to her that cæsarean section is a sure guarantee that one's child will be a genius. Mrs. Shandy, wiser than many of her modern sisters, indicates that she will chance having a less bright child, and Dr. Slop the diplomat explains that he was merely admiring what he knew it was to no purpose to propose. Finally the instruments are brought, so tightly tied into the bag by the zealous Obadiah that the lady almost dies before they can be extricated, and the delivery is effected with excitement if not with skill. The "vile instruments" crush the bridge of the infant's nose, a false one is made and fitted, and amid the "splenetic cordiality" of Dr. Slop and Susannah, Tristram is christened, though unfortunately with the wrong name. Mr. Shandy, of course, was the best obstetrician of them all—you remember his sage advice to the scientific operator, "Stay thy obstetric hand, return it safe to thy bosom to keep it warm."

The physicians of a century ago seem an eternity removed from our day, perhaps because the ailments they treated were so astonishingly unlike those we encounter now. What migratory inflammations there were then, and how disconcerting it must have been to check them in the chest only to have them break out in the brain. How dangerous night air was, and how quickly it could bring about a fatal issue, especially after surgery. How easily emotion caused tuberculosis or brain fever, and with what remarkable speed it precipitated labor. What a nuisance the relatives must have been, with their hysterics and their swoons. What an equal nuisance the nurses must have been, for their sensibilities were so strong that treatments were frequently halted while they were assisted to totter from the room, overcome by their feelings. What dreadfully protracted agonies the death beds were, and in what painstaking detail the patients were told that the end was to be expected and just how it was going to occur. Small wonder that even the dynamic Dr. Sampson, the famous advocate of the chronothermal theory of disease, which, as everyone knows, is based on unity, periodicity, and rhythm, is quite submerged under the weight of the pathology he must relieve.

There are many physicians in Dickens, but the portrait of none of them equals the matchless characterization of Sairey Gamp, most terrible and most delightful of nurses. Harold Skimpole was educated for medicine, among other things, but since he was a mere child in point of weights and measures—as well as in point of anything else that involved responsibility—he had never been able to prescribe with the requisite accuracy of detail, not to mention the fact that he usually couldn't come when summoned. Over his less pleasant traits it would be charitable to draw a veil. Richard Carstone took up medicine, I fear as too many are still taking it up, because it would do as well as anything else, but for my own part I am grateful that he did. Otherwise we might not meet Mr. Bayham Badger, whose surgical abilities fade into utter insignificance beside the delightful fact that he was the third husband of Mrs. Bayham Badger, and inordinately proud of having been preceded in her affections by those two distinguished gentlemen, Captain Swosser of the Royal Navy and Professor Dingo of European reputation. Dr. Parker Peps, who officiates at the closing scenes of poor Mrs. Dombey's life, in company with the insignificant Mr. Pilkins, is so accustomed to association with the nobility and so used to assisting at the increase of great families that invariably, wherever he is, he takes a leaf out of Mr. Weg's book and "drops into" titles. Another obstetrician of merit is the family physician of the Kenwigs, Mr. Lumbey, who has brought them all into the world from Morleena on down, and whose clientele is so prolific that he must even forego shaving.

Mr. Chillip, meekest of his sex, who moved as silently as the ghost in Hamlet and who came into a room sidewise to take up less space, we remember best sitting on the dark, draughty stairs whither he had fled to escape the piercing glare and the terrifying words of that martinet, Miss Betsy Trotwood. There is that unspeakable "pair o' sawbones," to quote Mr. Samuel Weller, Bob Sawyer and Benjamin Allen, whose sporting tendencies stick out all over them, who entertain their guests with case reports and who enliven the breakfast table with practical experiences in anatomy, on the principle that there is nothing like a good dissection to give one an appetite. The bottle is their unfailing recourse, they resort to the most ingenious expedients to create the illusion of a large and responsible practice, and Bob Sawyer doses his patients with calomel when other drugs happen to be out of stock and he lacks the wherewithal to replace them.

There are many others: the fashionable physician who misunderstood Mr. Merdle's case so thoroughly that the poor gentleman finally cut his throat; the filthy Dr. Haggage of the Marshalsea; the family physician of the Chuzzlewits, who pretends at the funeral not to know the undertaker, though he gives him many a bit of trade; and the dozen odd who enter with creaking boots and ticking watches and pompous

demeanor, and who are so omniscient that they invariably prescribe for their patients exactly what their lay attendants have just given them, and who naturally win considerable fame by so doing. As to the physicians who are worthy of their calling, I recall only two, Dr. Manette and Allan Woodcourt, and, like most of Dickens' heroes, they are not nearly as interesting as his villains.

One of the most famous physicians of fiction was created by the late Sir Arthur Conan Doyle, himself a physician, who, as he put it, abandoned practice because practice abandoned him. Dr. Watson is Greek chorus to that superman, Sherlock Holmes, for whom, as somebody says, he serves as a conductor of light, though not himself luminous. For luminous he certainly is not. He makes suggestions only to have them knocked down, he asks questions only to have his ignorance exposed, and when left to investigate anything himself, he omits no possible errors. But his lack of intuition makes Holmes' brilliancy the more scintillating, his reverent worship creates in us the same illusion, and without the blundering admiration of "My dear Watson" the whole edifice would fall. What sort of physician he was we are left to guess, and in his rôle of Boswell his practice must have been sadly full of interruptions, but one cannot help agreeing with Benet's paraphrase of Chesterton's delightful remark about Sairey Gamp, that he would rather die under the ministrations of Dr. Watson, with the chance of hearing a good story while he was doing it, than be saved by a more aseptic practitioner.

Austin Freeman has created a Sherlock Holmes up-to-date in Dr. Thorndike, and a Dr. Watson up-to-date in his satellite, Dr. Jervis. Dr. Thorndike is a super-detective, a physician versed in medical jurisprudence as well as in everything else on earth, for his knowledge is rather more marvellous than Holmes' own. He needs Dr. Jervis for contrast, but it might be added that his rebukes to his special *fidus Achates* are administered in a rather more delicate manner than are Holmes' devastating criticisms, though their effect is precisely the same.

The women physicians of fiction are mercifully few, for they are most of them thoroughly unconvincing ladies. Dr. Zay, Dr. Breen, Dr. Anna Prince, and Dr. Lurida Vincent were all depicted in the days when women were first battering at the doors of medicine, and they must have furnished excellent arguments against the admission to the ranks of any others of their sex, for more unprepossessing creatures it would not be possible to imagine. In fact, I know of only one woman doctor whom I should be willing to have around me if I should be hapless enough to need such services. She is Dr. Jean Gordon, the young Scotch assistant of Dr. Luke Serocold, and her womanly competence is sharply etched against the background of her impossible predecessors.

There is a group of young physicians drawn by physicians for whom literature had a stronger lure than medicine, which includes Stark Munro, Philip Carey, Kit Sorrell, Christopher Hazzard, and Edwin Ingleby. Most of them are excellently presented, but for the classic illustration of their kind we must go back many years, to Philip Lydgate of *Middlemarch*. Certainly he is typical of all the bright young men who begin their practice with ideals, and who find, as Paget says, that practice is the breaking of dreams. He began with dreams and visions, he ended without a single illusion, and a failure in his own eyes, though a success in the eyes of the world, because he had not done what he once meant to do. Sir William Osler was so impressed by the part his silly wife played in his career that he often reverts to it, warning his students to pick their mates carefully, and not too soon, to keep their affections on ice, and never, if they would be wise, to sport with Amaryllis in the shade.

Most of the realistic physicians of fiction have been painted by laymen and not by physicians. One of them is Anthony Trollope's Dr. Thorne, apothecary as well as physician, as all doctors, he says, would be if they consulted their own dignity less and the comfort of their patients more. Noble ladies with imaginary ailments often found him unsympathetic, but no poor woman lying on a bed of sickness ever thought him rough, and he is a great contrast to Dr. Fillgrave, who sat with dignity in his carriage and stepped with dignity up the front steps, but who did not have much ability beyond that, in spite of having persuaded the countryside that no one could die respectably without him. Dr. James Winter is a very delightful physician in *Round the Red Lamp*, who prefers inoculation to vaccination, who would practice bleeding freely except for public opinion, who regards chloroform as a dangerous innovation and the stethoscope as a new-fangled toy—though he is willing to carry one out of deference to his patients, since he is deaf and cannot hear out of it anyway. In spite of his whims he has the healing touch, because, unlike many scientifically trained physicians, he uses his hand and eye. There is Peter Harding, M.D., who in his letters from the Corner of Harley St. paints for us a charming picture of a physician and

who, Sinclair Lewis and his ilk to the contrary, manages to be happy and successful in his work because he loves his profession and is full of warm humanity and common sense.

There is Willy King, as real a personage as old Dr. Lavendar himself and quite as kindly a one. I have not read the chronicles of old Chester in years, but I seem to see him now in his ramshackle gig—was he described as chubby or do I merely imagine that he was? He was handicapped in his ministrations by the fact that he had been known to most of his patients since babyhood, and it is hard to receive castor oil from the hands of somebody to whom you once administered a spanking. And he was handicapped even more by his commonsense Martha, whose favorite occupation was to tell him and everybody else who would listen "flatly and frankly" what she thought of them, though his honest goodness would never let him admit her limitations.

I have a special fondness for Dr. Luke Serocold, G.P., the central character of Helen Ashton's novel, which has recently received the dubious distinction of being chosen as the Book of the Month. It was written by a former medical student, in answer to her husband's challenge that a whole book could not possibly be written about one day in the life of a doctor, and a most excellent answer it is. It runs the gamut of emotion, it ranges from birth to death, and it has at once the tremendous excitement and the everlasting monotony of detail that every day in a doctor's life holds. Dr. Serocold is a physician of the old school, trained in clinical rather than in scientific medicine, schooled to meet the emergencies of a country practice, sensitive to the spiritual as well as to the physical needs of his people. Every house, as he passes it, suggests an old patient or an episode of his practice, and he muses, as he goes on his way through the village streets, on the riddle of life and the secret of medicine, the solution of which is that since one cannot hope to cure people, the best one can do is to try to relieve them.

The most perfect antidote to the school of Arrowsmith is found in men like Dr. Serocold, and even more in men like Dr. William MacLure of the town of Drumtochty. Because his practice extended up and down the Glen, through rivers and over mountains, he had little time for reading and none for travelling, but he did what he could to keep up with the new medicine. He had not the grace of appearance, but the scars on his face and his body were honorable scars, got in the service of his people, and men are given the Victoria Cross for them in another line of endeavor. His clothing was nondescript, but when those breeks from which the checks were nearly gone were seen at the door, one knew that if human power could save a life, that life would be saved, for the sight of him put fresh courage into sinking hearts. He carried the heaviest weight of all his people, for he strove with death for them and he bore all their sorrows in his own heart, but he was too modest to realize that he had gathered more love than any other man in the Glen. As he had lived, so he died, withdrawn and still, in his ears the stammering prayer of his old friend Drumsheugh, "Almichty God . . . . dinna be hard on Weelum MacLure, for he's no been hard wi' onybody in Drumtochty. . . . Be kind tae him as he's been tae us a' for forty year. . . . Mind the fouk he's helpit. . . . the weemen an' bairnies . . . . and give him a welcome hame, for he's sair needin't after a' his wark. Amen." With the words of the Shepherd's Psalm on his lips, and the dream of his mother's kiss, he fell asleep, and "the peace on his face was of one who rested from his labors."

You remember the end of the tale, I am sure, the simple burial service in the snowdrifts, with his own people about him to do him the honor and show him the love they had always borne for him, though perhaps they had seldom expressed it in his life. You remember the shepherds in their blacks, the Laird of the Glen uncovered, the cynic Jamie Souttar with tears on his face, the women and children weeping quietly as the little procession went by. You remember the minister's prayer, "That we might have grace to live as this man had done from youth to old age, not for himself but for others, and that we might be followed to our grave by somewhat of 'that love wherewith we mourn this day thy servant departed.'" And so the Glen laid him to rest, this man who had served it for more than forty years with a devotion that knew no reserve, with a kindliness that never faltered.

I began this rambling paper, Gentlemen of the College, with the story of a callous and cynical physician whose ideal, if such a person can be said to have an ideal, was devotion to pure science. I close it with the story of a simple-hearted, kindly doctor, untrained in the new efficiency, whose ideal was service to his people. I have no moral to point, but it has crossed my mind as I wrote that perhaps it would be well for us to remember, since we are of the new day in medicine, that when they come to pass through the Valley of the Shadow of Death, it is not upon the Arrowsmiths but upon the William MacLures that men and women would cast their burdens.

OBLIGATIONS OF THE AMERICAN COLLEGE OF SURGEONS TO MEDICINE AND TO THE PUBLIC[1]

GEORGE W. CRILE, M.D., F.A.C.S., CLEVELAND, OHIO

IT is well for any organization occasionally to define its aims and review its achievements. It is of special importance to make such an accounting of the aims and achievements of the American College of Surgeons tonight, when we have met for the purpose of welcoming into Fellowship you who have been selected for this distinction, because you should not only understand the purposes of this great institution but you should also be familiar with its achievements in the past, in order that you may be prepared to play your part in its further progress.

The purposes of the Founders of the American College of Surgeons as stated in Article II of its By-Laws are as follows:

> "The object of the College shall be to elevate the standard of surgery, to establish a standard of competency and of character for practitioners of surgery, to provide a method of granting Fellowships in the organization, and to educate the public and the profession to understand that the practice of surgery calls for special training and that the surgeon elected to Fellowship in this College has had such training and is properly qualified to practice surgery."

Seventeen years ago when the American College of Surgeons was founded, the public, encouraged by the rapid advances made by the physical, biological, and medical sciences, had already subscribed millions of dollars for medical research, for medical education, for hospitals, and public health services, but in the new world of surgery which had developed during the period from 1875, which Glenn Frank last year termed the period of the Medical Revolution, every surgeon made his own laws of action and every hospital felt free to establish its own code of standards.

The rapid rise of surgery during the last decade of the nineteenth and the first decade of the twentieth century brought with it certain inequalities of income between the physicians and surgeons, and since during most of this period there were not enough well prepared surgeons to perform all of the needed operations, there developed a large number of dimorphic individuals—physicians and surgeons. The surgical work done by these men represented the best they had to give, but only too frequently it was comparatively poor. Many of these dimorphic practitioners later devoted themselves exclusively to surgery but finding that surgical opportunities came more slowly than they desired or had anticipated, some of them adopted the practice of fee-splitting. As a result of these conditions, not only was the surgery of this country extremely uneven, but it was subject to no control, and hospitals and hospital organizations came into existence with such rapidity that they also were extremely uneven in their order of efficiency and they too were subject to no regulating authority.

If any great and powerful group ever were in need of leadership it was this group composed of surgeons and the vast hospital system used by them. Not only was there no government agency competent to censor the standards of the surgeons and hospitals but there was no educational agency which could assume such authority. The medical colleges could not correct these great evils for they themselves had but recently been redeemed by a committee of the American Medical Association under the able leadership of Dr. Arthur Dean Bevan and by the survey made for the Carnegie Foundation by Abraham Flexner who, in 1910, made the statement that "our medical education includes something of what is best and all of what is worst to be found among civilized nations."

The American Medical Association could not assume the responsibility of authorizing a minimum standard for surgeons and hospitals for its great task is to assume leadership for every physician who is morally and professionally prepared to practice. The American Surgical Association is a small society which includes many of the teachers of surgery, but this society sets a standard which is far above minimum requirements and has a membership of only about 150 from among the more than 30,000 surgeons in the United States and Canada. A like statement may be made regarding the Society of Clinical Surgery. The regional surgical societies, such as the New England Surgical Society, the Southern Surgical Association, the Western Surgical Association, the Pacific Coast Surgical Association, etc., could not assume leadership for the entire surgical profession of the country. It was clear, therefore, that existing societies were limited geographically or had standards so high as to exclude many well qualified surgeons or were so democratic that their standards were too low. It was evident that some organization was required which could exert moral authority over the great and increasing number

[1] Fellowship Address delivered before convocation of the American College of Surgeons, Philadelphia, October 17, 1930.

Geo. Cole

UNIV. OF H.

of surgeons and hospitals throughout the United States and Canada.

The magnitude of the task which would have to be assumed by such an organization becomes obvious when one considers that in spite of the urgent need no such organization could be endowed with absolute authority to standardize hospitals and surgery; when one considers the extremely independent thinking and feeling of surgeons who are trained to be self-reliant and to make their own decisions; when one takes into account the fact that any organization which could undertake this task would require the expenditure of millions of dollars with not a dollar in sight; when one realizes that such an organization must extend like a great network across the North American continent; and of special and vital importance, when one considers that any standard which would be established by such an organization would inevitably be condemned by many of the leaders in surgery who would feel that the standard was too low and by large numbers of partly qualified surgeons who would feel that the standard was too high.

In order to effect an adequate organization which could assume such moral authority and could raise the necessary funds, a leader of statesman-like ability and exceptional courage was required. It is said that the need creates the man, and certainly one man appeared who, himself an outstanding surgeon, was qualified and had the venturesome spirit to risk everything in this great task. This man was Franklin H. Martin. With clear vision, he requested and secured the membership of the established surgical societies. But this initial membership in this newborn American College of Surgeons was but a nucleus, for it was clear that if this movement were to succeed in gaining a winning momentum, all the leading surgeons of the country must be included. Dr. Martin, therefore, with the spirit of an evangelist, personally visited the principal centers throughout the United States and Canada, adding leading surgeons to the original membership. The surgical importance of these initial members constituted the moral authority for the great work that was to follow. The maintenance of the original impetus showed clearly that only a bold stroke courageously executed could have won.

Mistakes have been made in the past; more mistakes will be made in the future. That is inevitable, for who can know with certainty what is the minimum standard for the surgeon, and what is the minimum standard for the hospital? It is clear, however, that the group of men who can most accurately judge the present minimum standard for the surgeons and hospitals of this country and Canada are the Credentials Committee of the provinces and the states, the Central Credentials Committee, the active surgeons who serve on the Board of Governors, and the Board of Regents, together with the Director General, the Director of Hospital Activities, and the Director of Clinical Research of the American College of Surgeons.

Through death, the older ranks are steadily disappearing and whatever criticism there may have been against the judgment of the earlier group, time will relieve the critics of their embarrassment and will hand on to younger surgeons the torch with which they may further blaze the trail. The standardization of surgeons and hospitals will be constantly changing, the minimum standard will rise and fall with the type of young men who enter the field, with the state of medical science that they create, with their teaching in the medical colleges and with the work that they demand from their students.

Let us consider for a moment the conditions which exist today which the American College of Surgeons must do its part to meet. The following figures will give some idea as to the magnitude of the task:

Approximately 1,500,000 individuals in the United States and Canada are employed constantly in connection with the care and the prevention of disease and injury. There are 164,692 regular practitioners in the United States and Canada and their dependencies; 200,000 graduate nurses are registered in the United States and Canada; 1,419,719 patients are in hospitals daily, and over 12,000,000 patients enter hospitals annually in these two countries.

The total monetary value of hospitals—real estate, buildings, and equipment—devoted to the care of injury and disease in Canada and the United States is no less than five billion dollars, and the daily cost of maintaining these 8,065 hospitals and 5,726 clinics and out-patient departments is three million dollars, or over one billion dollars annually. These figures are enough to show you the magnitude of the armamentarium required in the fight against disease.

Let us now look at another phase of this great task. According to the statistics of the National Safety Council last year, there were 10,000,000 accidents and 97,000 accidental deaths in the United States alone. This is comparable to the American casualties in the Great War—indeed we are at war constantly with the complicated machinery of our civilization—yet this is an

annual loss. The total number of cases of disabling illness in the United States alone, annually is 130,000,000 and there are estimated to be twice this number of non-disabling illnesses. The total number of working days lost annually in the United States by wage earners is 250,000,000. The total number of school days lost annually by school children on account of illness is 170,000,000. It is estimated that the total number of surgical operations in the United States and Canada annually is above 1,000,000. The total number of visits to clinics or out-patient departments annually is 30,000,000. The total number of births annually is 2,000,000.

As for the defectives in our population, there are 900,000 mentally defective; over 100,000 individuals who are totally blind; over 1,000,000 who have major speech defects, and over 3,000,000 children who are wholly or partly deaf.

Now what has the American College of Surgeons done to meet these conditions? How have the funds invested in the College been used for physical properties, for the purposes of standardization, and for research to discover means for the prevention and treatment of disease? First of all, there is the physical property in Chicago—land and buildings valued at approximately $1,600,000. There are endowment funds to the value of $839,000. From the first day to the present time this organization has paid its way, the total amount expended since its foundation amounting to $1,988,538, while the total assets of the College amount to $2,410,425. In fact the total value of the tangible assets of the College, of which the real estate is the principal item, within a few years will probably be greatly in excess of the total amount of money paid into the College by the Fellows since the time of organization.

During the past 17 years there have been 147 sectional clinical meetings, and 18 convocations. Including those received tonight 11,184 Fellows have been received. Of these 1,290 have died, making the present membership 9,894. One hundred and two honorary fellowships have been conferred.

During these few years, obviously the major task has been that of standardizing the hospital and the surgeon as well as those who serve within the hospital walls—the superintendent, physicians, nurses, laboratory assistants, etc., all of whom come under the influence of this vast undertaking. The labor involved in carrying out the standardization program has been truly stupendous. Dr. MacEachern and his associates have visited practically every hospital in the United States and Canada in addition to preparing a standardization program for every regional meeting and every convocation. The value of hospital standardization is further attested by the fact that the College was asked to survey the hospitals of the United States Government—the Army and Navy Hospitals, the Public Health Service, the Veterans' Hospitals and the National Homes for Disabled and Volunteer Soldiers, and also the hospitals of New Zealand and Australia, with a view to their standardization, for which duty Dr. MacEachern was assigned.

Mention should be made here of the co-operation of various organizations in this part of the program of the American College of Surgeons. I refer especially to the American Hospital Association, the Catholic Hospital Association, the American Protestant Hospital Association, the Board of Hospitals, Homes, and Deaconess work of the Methodist Episcopal Church, and the Council on Medical Education and Hospitals of the American Medical Association.

Surely it must be gratifying to all those who have had a part in this movement to feel that the occupant of each of the 985,000 hospital beds in the United States and Canada owes something to the American College of Surgeons for the quality of the service he received. In particular, every patient of today and of the future owes a definite debt to the intelligence, industry, and sympathetic understanding of Dr. MacEachern for the hospital standardization program which has become one of the finest services to medicine ever rendered by an organization.

The policy of the College to conduct researches has beckoned us to a field all our own, unlimited in extent and unappropriated. This is a research in which each and every one of our Fellows has a part. It is research conducted by practical surgeons and is based on the findings of men who actually do the work. The various committees—six in number—of which the Department of Clinical Research is comprised, are constantly engaged in summarizing and making available clinical and experimental data. Thus the Department of Clinical Research under its able Director, Dr. Bowman C. Crowell, is playing an important part in the standardization of the surgeon.

Such have been our principal accomplishments, but let us summarize briefly all the various activities of the College during these 17 years:

1. *The Clinical Congress.* An annual Clinical Congress has been held, the high standards required by which have affected not only the surgeons who have taken part in them but also the environment in which the doctors do their work. That is, they have borne an important

share in the work of standardization of the surgeon and of the hospital.

2. *Fee-splitting.* As the result of the stand of the College in regard to fee-splitting, this practice is frowned upon by all decent medical practitioners. Moreover, the College has helped to place upon the statutes of eight states anti-fee-splitting laws that have for their object the protection of the public against this practice.

3. *Consideration of applicants for fellowship.* The Committees on Credentials have played their part in a most efficient manner and have maintained the standard that has been set for qualification for Fellowship. The Committee on History Reviews in Chicago, comprised of teachers in the four medical schools in Chicago, annually reviews in the neighborhood of 60,000 individual records and brings to focus on each case a careful analytical judgment. The members of this committee work without compensation other than a sense of duty well done.

4. *Inter-American activities.* The influence of the College has extended to all of the Americas—the entire Western Hemisphere.

5. *Judiciary committees.* These committees of each state and province handle complaints in reference to the Fellows which are filed with the College.

6. *Library and Department of Literary Research.* This service covers the compilation of bibliographies and the preparation of abstracts and translations or complete reviews of the literature to assist the doctor in his clinical work, in his experimental investigations, or in the writing of his medical and surgical papers.

7. *Clinical research.* The committees organized under the Department of Clinical Research are:

(1) Committee on Bone Sarcoma, (2) Committee on Treatment of Malignant Diseases, (3) Committee on Archives of Malignant Diseases, (4) Committee on Fractures, (5) Committee on Standardization of Clinical Laboratories, and (6) Board on Traumatic Surgery.

8. *State and Provincial Sectional Meetings.* The American College of Surgeons was the first medical organization to make an organized appeal to the public and to take the public into partnership. It has always emphasized the necessity of keeping well, and has informed the public how to select a competent physician, a competent surgeon, and a good hospital; and also means of recognizing the evil of fee-splitting.

9. *Health Inventoriums in the Hospitals.* Through the Health Inventoriums, the College is endeavoring to place at the disposal of every qualified practitioner of scientific medicine the facilities which will enable him to make a complete and thorough examination of his patients.

10. *Hospital Standardization.* Briefly, the following are the points covered in our Minimum Hospital Standard:

(1) Organized staff; (2) membership upon the staff restricted to physicians and surgeons who are in every way competent and worthy in character and in matters of professional ethics; (3) staff meetings to analyze the work of the staff; (4) the keeping of case records; and (5) proper diagnostic and therapeutic facilities for the care of patients.

In brief then we may say with confidence that the American College of Surgeons not only has an asserted program, but it is actually doing the work.

The credit for these achievements and for the creation of perhaps the most useful and most powerful surgical organization in the history of medicine is due to the collective effort, to the contributions, to the willingness of every Fellow in the College to co-operate, to the time and intelligence of the Credentials Committees, to the permanent Credentials Committee, to the Committee on History Reviews, to the Board of Governors, to the Board of Regents, and supremely to the Director General and his permanent staff—the executive force to whose ability and efficient service must be credited a large share in the accomplishments of these 17 years.

Whatever the physical achievements of the College, whatever its organization, it cannot exist without *you*—the body of Fellows. As Sir Rickman J. Godlee, of London, stated in the Fellowship Address given at the First Convocation of the American College of Surgeons in 1913—"These things are, however, merely the outward coverings of the skeleton of the College. *You* are the flesh and blood, the circulation, the *primae viae*, the nerves and the brains, and it is for you and you alone to work out your own salvation." And so, my colleagues, who are tonight being recognized as Fellows of the American College of Surgeons, on behalf of the officers and Fellows of the College, it is my pleasant duty to welcome you as an integral part of this great organization with the hope that each of you will enjoy in fullest measure the rights and the privileges of Fellowship.

CONFERENCE ON ELECTROSURGERY

ELECTROSURGERY[1]

HOWARD A. KELLY, M.D., F.A.C.S., BALTIMORE, MARYLAND

ELECTROSURGERY, sometimes vaguely called diathermy or more specifically surgical diathermy, is still a comparatively new and astonishing development within the broad field of general surgery and is destined to effect a profound readjustment of our surgical technique. While the surgical operation is identical as to its objective, the method, the *modus operandi*, is widely different, being a skillful adaptation of our recent discoveries in generating and manipulating high frequency electric currents whereby they are made to furnish a rapid flawless technique in the excision and destruction of new-growths and in the sterilization of tissues.

At the very outset, it is incumbent upon me to pay a tribute to W. L. Clark of this city, who first clearly apprehended the possible and unique performances of electrosurgery and who devised the necessary instruments for its effective use, while battling with the inevitable professional skepticism with persistence and patience until we all are now ready to grasp this inestimable boon. The reluctance of our conservatives to accept Clark's novel procedure has been due, it seems to me, to our ingrained conservatism bolstered up by an utter lack of comprehension of its principles, methods, and results, under the impression that after all it is nothing more than just some other kind of cautery. To those who at last have learned its technique and its possibilities, in its proper special fields it is as far superior to our most ancient and honorable scalpel surgery as is the electric tramway ahead of the lumbering horse cars of our youthful days.

It is indeed a curious reflection that after milleniums of scalpel surgery, with its attendant ligating, needling, and suturing, in this new age so ancient a craft as ours should be called upon, like Benjamin Franklin, to snatch the power from the lightning which flashes in the heavens and from the electric spark of the rubbed amber with which to attack our worst enemy, *cancer*, with no greater a weapon in hand than the humble sewing needle of our grandmothers, used as a terminal that remaining cold itself becomes the terminal of the intense current which boils the tissues and destroys the disease.

The surgical concept of the area to be attacked and destroyed, be it emphasized, remains much the same, while the difference between the old and the new lies in the mechanism by which the thing is done, not forgetting, however, some remarkable extensions of the field. In the actual performance, we use a large indifferent pole well adjusted to some expansive part of the body and a small active pole at the point where the current is concentrated at a million or more oscillations per second to boil the fluids and produce a necrobiosis within the adjacent tissues on all sides about the needle thrust in from a few millimeters up to a centimeter. Each operation in its totality amounts simply to a multiplication of these unit-treatments, administered with a rapidity in accord with the intensity of the current, with a voltage and amperage regulated to deliver anything from a flashing flame of miniature lightning down to the almost invisible spark usable with safety on the eyeball. The large or small area thus rapidly destroyed is either left *in situ* to be cast off in a few days or is curetted away at once with an ordinary scoop, or with an electrosurgical scoop, or with a simple wire loop. Successive layers are thus easily removed in working into the depths, often with no hæmorrhage. If a large vessel bleeds, it is isolated and caught with a fine pointed forceps and the current turned on to shrivel and occlude it. Obviously an operation done in this way avoids all direct contacts and other manipulation of the tissues on the part of the operator.

Electrosurgery is thus *par excellence* a knife and fork procedure; quite appropriately this homely designation marks one of its major advantages, being almost as much a differentiation from antecedent methods as its novel use of electricity. Nothing, I think, should impress the onlooker more than to witness such an operation from start to finish. It eliminates all direct contacts with the operator, who sits perched on his stool like Simon Stylites poised thirty feet in the air on his column, ministering to the little world at his feet,

[1]Presented before the Conference on Electrosurgery, Clinical Congress of the American College of Surgeons, Philadelphia, October 13–17, 1930.

yet far removed from its physical contacts and contaminations.

Another pre-eminent characterization is the almost complete rejection of ligatures, a particular gain in destroying the deeper parts layer by layer. An electrosurgical operation is almost never halted because of a hæmorrhage which we dread to risk again.

Let me name categorically the differences between general and electrosurgery, in each of which I hold the latter as superior:

(1) Cases oftener ambulant; (2) wider use of local anæsthesia and brief gas anæsthesias; (3) use of cutting current instead of scalpel (Wyeth); (4) few and simple instruments; (5) great facility for delicate dissections with cutting current; (6) tissues not handled; (7) hæmorrhage greatly lessened; (8) few or no ligatures; (9) clear field at all times so that operator sees and controls every step; (10) sterilization of tissues by current; (11) destruction of diseased cells or infection *pari passu* as operation advances; (12) diseased glands exploded often *in situ* and left for absorption; (13) operation more easily carried into the depths, in mouth, vagina, rectum, and abdomen; (14) duration of operation often much shorter; (15) less postoperative pain as nerve ends are cooked; (16) healing more rapid than in an average surgical case left to granulate; (17) scar softer and less disfiguring; (18) after-course aseptic (tissues treated with an antiseptic solution and simple dressings used); (19) follow-up work on overlooked or recurrent areas easier; (20) operating, especially in infected areas, a pleasure.

If these claims for electrosurgery are justified, it is obvious that sundry accessories, which through the centuries we have tacitly accepted as "indispensable," characterizing, and pertaining to the very essence of surgery (much as our forefathers as a routine called for boiling oil for hæmorrhage in amputations), are really objectionable opprobria, the removal of which constitutes a priceless gain. I refer obviously to hæmorrhage, to manipulations of the tissues, and to ligatures. Among the more startling expositions of the resources of electrosurgery are extensive operations about the face, including often both lower and upper maxilla and more or less of the hard palate. In this hazardous and difficult field, the electrosurgeon proceeds unhesitatingly from start to finish, unaware that any extraordinary difficulties are being overcome. Those of us further along in years will readily recall in our student days the formidable nature of such an operation even to our great surgeons, Gross, Agnew, Jimmie Wood, and others, when the bold, dashing operator sometimes met his embarrassments with a theatrical show, hastening on account of the hæmorrhages, while grasping the bone with stout lion jaw forceps and vigorously wrenching the superior maxillary from its setting; nor shall we forget the pride when the patient was shown alive later, recording a temporary success. But, alas, in the end, the futility of it all and of the breast amputations and of many similar efforts.

In brief summary, some of the conditions with which we deal are:

Various malignancies about face, lips, mouth, tongue, fauces.

For carbuncles it renders signal services in exsecting the diseased area, leaving a clean, sound, aseptic, rapidly healing wound; in fact, it undoubtedly replaces the actual cautery which has been growing in favor and is infinitely superior to the wretched poulticings.

No method outside of the wonderfully effective services of radium is worth considering in dealing with malignant tumors of the scalp.

In malignancy of the skin in all parts of the body, electrosurgery is second only to radium; it supersedes radium in nævi. Often when the use either of the X-ray or radium has been overdone and there still remains a sclerosed or an extensively ulcerated mass, nothing approaches the efficiency of the exsections of electrosurgery.

Epitheliomata of the dorsum of hand or wrist, even when the growths extend into the tendons, are admirably handled by electrosurgery which is secondary only to radium well managed.

For certain breast cases it is supreme, especially in the presence of nodular, ulcerated, massive scirrhous breasts, when there is not a shadow of a hope of a successful removal by classical methods. In such case electrosurgical extirpation of the mass often proves of inestimable value in stopping the pain and the discharges, as well as in freeing the poor victim of the unsightly reminder of a doom daily approaching. Nor need one always hesitate even when there is fixation of one or more massive glands. After the main mass is removed, areas of lingering disease can often be coagulated out of existence and glands can be removed or, with the fire of the heavy flashing current, destroyed *in situ* and left to be absorbed. Some patients in this group express more gratitude for relief than others do for a radical cure. In many instances recurrences are slow to occur and when the patient is old, it becomes a special blessing as she may go to the end apparently cured.

Malignancies about the abdomen offer a fertile field for electrosurgery. We can destroy papillomatous ovarian implants faster than it can be

stated. Small areas of carcinoma are readily destroyed and left where found, while a scirrhous nodule in the intestinal tract can be widely destroyed even through into the lumen of the bowel and abandoned after turning it in and suturing the wound with a couple of Lembert sutures. In resecting the bowel for malignancy, if one finds an affected gland in the fork of a large mesenteric vessel distant from the field of operation, it can be wiped out of existence by puncturing it and coagulating the whole gland, if needs be grasping the vessels with the fingers to limit the transmission of the heat.

Malignant vulvar disease should always be removed by electrosurgery and any inguinal glands sparked out of existence.

In experiments on the liver and kidney, Ward and Pearse have resected portions of both organs with a marked lessening of the hæmorrhage. In the liver there was practically no bleeding during excision of a complete lobe. In nephrotomy and partial nephrectomy, in spite of the large arterial supply of the kidney bleeding was markedly diminished in the peripheral areas. In the neighborhood of the pelvis, the larger vessels required clamping and coagulation. Scott has carried this into the clinical field, removing portions of the kidney for tumors and stone.

Electrosurgery is opening up a large field in brain work as it will in spinal cord surgery. In the brain, as shown by Cushing, electrosurgery is of the greatest value in opening up the meninges, in making safe a passage to an abscess, and above all in the effective handling of hæmorrhage. It also enlarges the field of control over malignancy, simplifying the removal of the disease in sterilized "curls" and in the further treatment of the encapsulating tissues by coagulation. In the spinal cord it is easy to prognosticate a use in all lesions where it is simply necessary to divide a nerve trunk or to destroy benign or malignant growths *in situ* without the usual protracted manipulations for exposure and removal with the attendant traumatisms.

In all these operations, it is advisable to maintain the careful technique of the operating room in major and minor surgery. This should be done for our own sakes and in no wise to impress the patient. How far we may safely modify our stringent technique will appear only after considerable experience.

In closing, I feel profoundly thankful that our honorable society, composed as it is of our leading surgeons, is seriously taking this matter in hand. Personally, I give thanks for such a new and potent adjuvant which simplifies our technique, speeds the operation, does many things better, and some things heretofore impossible, while it greatly lessens pain and the liability to subsequent infections.

ELECTROSURGICAL UNIT AS AN AID TO THE NEUROLOGIC SURGEON[1]

ERNEST SACHS, M.D., St. Louis, Missouri

EVERY surgeon introduces modifications in his technique from time to time, and though he insists upon these changes because they facilitate his work and thus afford him great satisfaction, he does not delude himself into believing that they are essential to the success of his work. It is only very rarely that we make a change in our technique which is fundamental and involves a radical departure from former procedures.

The technique of neurosurgery, as it has been developed in this country, calls for a variety of instruments and apparatus. Prior to 3 years ago, however, there were, in my opinion, only two devices which could be considered epoch making contributions to the technique of neurosurgery: first, the use of Horsley bone wax; second, the use of the Cushing silver clip for the control of bleeding from vessels in the brain. When Cushing, with the help of Bovie, applied electrosurgical technique to neurosurgery, the third great advance in technique was made.

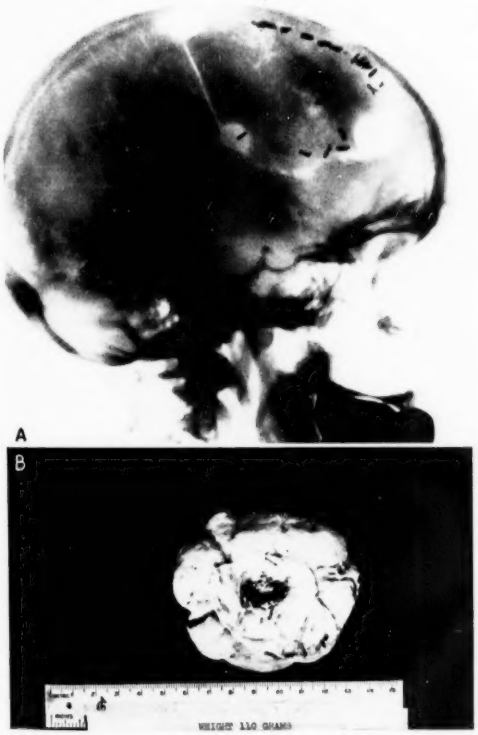


Fig. 1. A, Appearance in the X-ray plate of the operative field after removal of a meningioma. Note the large number of silver clips that were used before the days of electrosurgery. B, The tumor, showing its dural attachment.

Five or 6 years ago, when Kelly first described the use of this method in general surgery, I made some desultory attempts to apply it to my work, but was obliged to give it up because I did not have the knowledge to perfect the apparatus. The experiments were tried only on animals. The apparatus I used caused contractions of the muscles of the extremities because the rate of electrical interruptions was not sufficiently rapid and irritated the cortex. Also, both the animal and operator received a shock from "shorting" through the table. These and other difficulties have been overcome in the machine devised by Bovie. This apparatus delivers a damped current with some three million interruptions per second. For the past 2½ years, however, since the Bovie unit has been available, I have used it constantly and, after 2 years of use, I still am continually finding new ways of applying the apparatus.

There are various combinations in which the dehydrating, coagulating, or cutting current may be used. I firmly believe that any apparatus which only cuts and does not at the same time coagulate, is of little, if any, value. Some coagulation must be an essential characteristic in any such instrument and is produced by the damped current.

As I have come to use this apparatus in brain cases, I have applied it in 3 ways. The first is to coagulate all blood vessels of considerable size, both in the dura and on the cortex. I do not attempt to coagulate vessels instantaneously; that I have found dangerous, because instantaneous coagulation requires a very strong current and this may rupture the vessel. I take hold of the vessel with a bayonet forceps and run a current through the forceps, which shrivels the vessel and thus occludes it. By using the current for this purpose and in this way, I have almost entirely given up the use of silver clips in the past 18 months. Once in a while I may still resort to a clip, but whereas formerly 50 or more clips had to be used in removing a tumor, today, in many

[1] Presented in the Conference on Electrosurgery, before the Clinical Congress of the American College of Surgeons, Philadelphia, October 13-17, 1930.

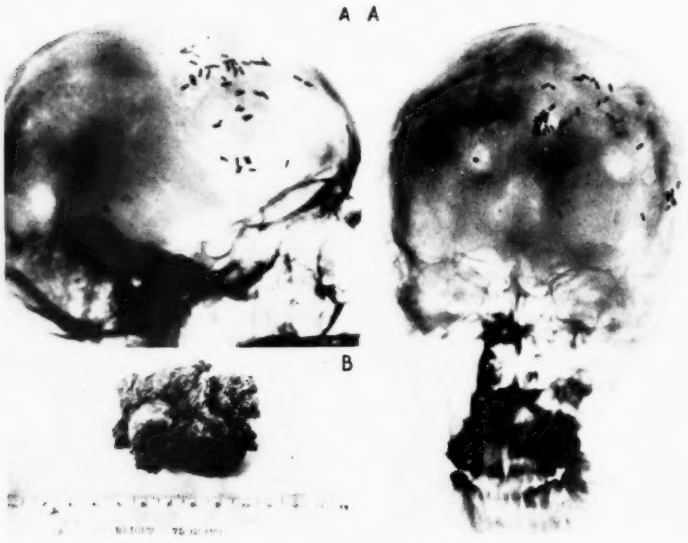


Fig. 2. A, Appearance in the X-ray plate of the operative field after removal of a meningioma attached to the falx. B, Meningioma removed.

tumors, only 1 or 2 clips are used and not infrequently none at all.

The second method of applying the current is to cut through normal cortex with a knife-like blade whenever dealing with a tumor that is poorly encapsulated. In order to do this satisfactorily, after coagulating the vessels that are to be divided, the cortex over the central portion of the convolution is blanched with a low coagulating current so that the incision will be perfectly dry. Formerly, after the vessels were clipped, the cortex was incised with an ordinary knife. The great advantage in using the electric knife is that the appearance of the subcortical tissue remains unchanged which enables the surgeon to recognize whether or not he is working in normal tissue. With the old method, the subcortical tissue very quickly became discolored by pin-point hæmorrhages with the result that it was impossible to tell whether the tissue was normal or diseased. Some have raised the point that the amount of cortex destroyed with the electric knife is greater than with an ordinary knife because of the coagulation of tissue adjacent to the incision. If, however, one considers the injury to the cortex by the innumerable ecchymotic spots when a knife is used, the difference is negligible and in favor of the electric knife.

The third method of using this instrument is to core out with a loop the center of a large tumor so that the shell of the tumor may be collapsed and removed with less trauma to the surrounding cortex. This method is particularly applicable to meningiomata but also can be used in cases in which the tumor has a fairly well demarcated border. Sometimes, if a tumor is very soft, it can be charred with the loop and then cored out or removed with the electric needle. Other tumors that can be very satisfactorily dealt with are some of the angiomata. In these cases, if one vessel after the other is slowly coagulated, it is possible to remove the tumor bloodlessly. Where vessels of considerable size are to be coagulated, great care must be taken lest the current be so strong that it will rupture the vessel suddenly, for this would result in violent and, at times, alarming hæmorrhage. Some men have claimed that postoperative hæmorrhage is more frequent with this method than with the older technique. This has not been my experience. The vessels should not be coagulated by simply running a current down a clamp momentarily, but a longer time should be used for each coagulation. With this precaution, I believe this method is safer than occluding vessels with clips.

I have seen a number of statements in the literature advocating this technique on the ground that it was a time saving device. Though it may save time in other surgical procedures, that is not the case in my experience and that is neither its

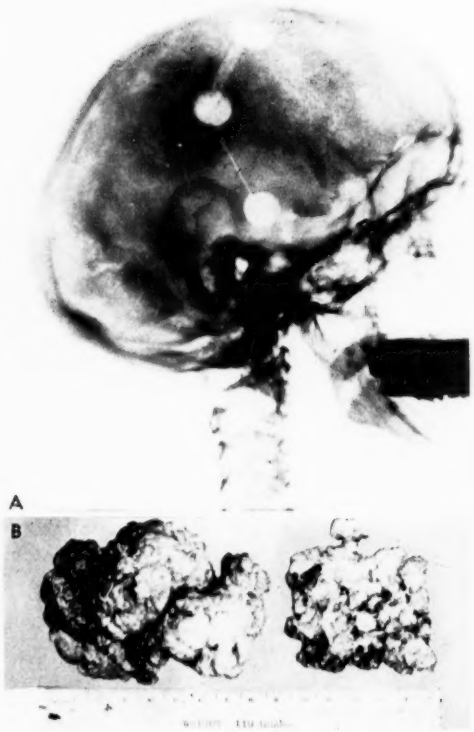


Fig. 3. A, Appearance of operative field after removal of meningioma with electrosurgical technique. This tumor lay on the floor of the middle fossa and was attached to the greater wing of the sphenoid. The base was very broad and huge vessels ran into the tumor. Only one clip was used throughout the operation and this one proved unnecessary as the vessel was coagulated. B, Tumor removed piecemeal, cored out with loop.

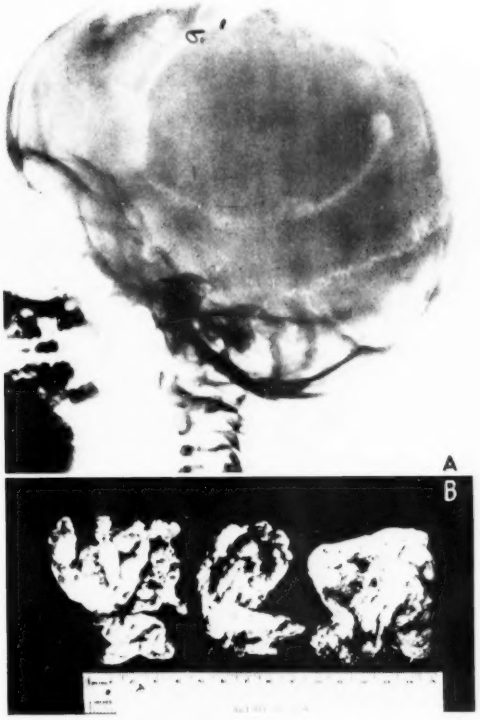


Fig. 4. A, Appearance of operative field after removal of an ependymoma which was partly cystic and partly solid. Only one clip was used in this case; the other metal appearing in the picture is silver wire that was used to hold the flap in place. B, Tumor removed piecemeal, partly cored out with the loop.

purpose nor the reason for advocating its use in this field.

SUMMARY

1. Electrosurgery is the most important addition to neurosurgical technique that has been devised in many years.

2. By means of this method, brain tumors can be dealt with that have been inoperable heretofore, and tumors that were operable can now be removed with greater safety.

3. The technique of this procedure takes time to learn and as our experience increases and its possibilities are realized, more and more can be accomplished with it in the future.

ELECTROSURGERY IN GOITER OPERATIONS[1]

MARTIN B. TINKER, M.D., F.A.C.S., Ithaca, New York

ELECTROSURGERY in goiter operations under suitable conditions and in suitable cases offers 4 important advantages:

1. It saves blood by sealing the capillaries and smaller blood vessels.

2. This sealing of capillaries, blood vessels, and lymphatics also proves an important factor in preventing the spread of malignancy, and in preventing thyroid toxæmia.

3. It saves time by sealing smaller blood vessels by a touch of the electrode to artery forceps instead of tying a ligature or suturing; in large vascular goiters this reduces the time of operation one-quarter or more.

4. It tends to give better healing: (a) by avoiding filling of the wound with blood serum; (b) by electrical destruction of bacteria; (c) by avoiding leaving catgut, silk, or other foreign material in the wound.

The methods of use are two: first, the cutting current, fast, medium, or slow, is used mainly to prevent oozing from glandular tissue, which is extremely vascular; second, coagulating current, medium or intense, is used to seal small or moderate sized vessels. The use of the electrical cutting current requires an entirely different touch from the use of the scalpel where pressure is required, while with the electrical cutting current one is concerned almost entirely with guiding the direction of the instrument. Most surgeons are trained in the use of sharp cutting instruments and will get a better skin scar by the use of the scalpel. In the case of malignancy the rapid cutting current may be used in the skin and satisfactory *per primam* healing can be obtained. The slow cutting current gives better arrest of bleeding and is what I have usually used on the goiter itself. In dealing with blood vessels of considerable size, it is best to pick up the vessels with artery forceps as if a ligature were to be used and a touch of the electrode to the forceps with the slow coagulating current will usually seal smaller vessels quickly and effectively. The amount of time saved in this way in dealing with a large vascular goiter is considerable. The destruction of tissue by the electrical current is slight and apparently less likely to interfere with healing than the use of the ligature. A small or large loop can be used with moderate cutting current to remove tissue in much the same way that it is removed by a curette. Frequently in an effort to save an adequate

Fig. 1. Shows line of incision at the surface of the goiter, which ordinarily absolutely safeguards the recurrent laryngeal nerve and parathyroid bodies. Almost equally important is the saving of the blood supply, which as shown in the cut, is most freely distributed on the surface of the gland. Even a very thin shell of tissue with unimpaired blood supply will produce sufficient thyroid secretion. (After Kocher, *Chirurgische Operationslehre*, 5 Auflage, Fig. 292, p. 664, 1907.)

Fig. 2. Shows use of electric cutting near anterior surface of the goiter. Larger vessels are picked up with artery forceps before cutting is begun. Deeper vessels are controlled by fingers of left hand. Fingers of left hand are also able to control the depth of cut and thickness of shell of tissue left. Insert gives a cross section of this part of the operation.

Fig. 3. Shows use of cutting loop to reduce the thickness of the shell of tissue which is left. Cutting also controlled by feeling through the shell of gland with left finger tip. Lower insert shows cross section illustrating use of cutting loop. Upper insert shows coagulation of medium size vessels by electric contact. The current control is changed from cutting to coagulation.

Fig. 4. Shows closure of thin shell of thyroid tissue which is left. Cross section shows infolding to obliterate dead space, and to prevent oozing. The proportional amount of tissue should be much thinner in operating for more toxic exophthalmic goiters. With large obstructive adenomata, the patients having a low or normal metabolic rate, the amount of thyroid tissue saved should be liberal in order to avoid hypothyroidism. It is also usually possible to save relatively normal glandular tissue which is ordinarily easily distinguishable from diseased tissue.

[1] Presented in the Conference on Electrosurgery, before the Clinical Congress of the American College of Surgeons, Philadelphia, October 13-17, 1930.

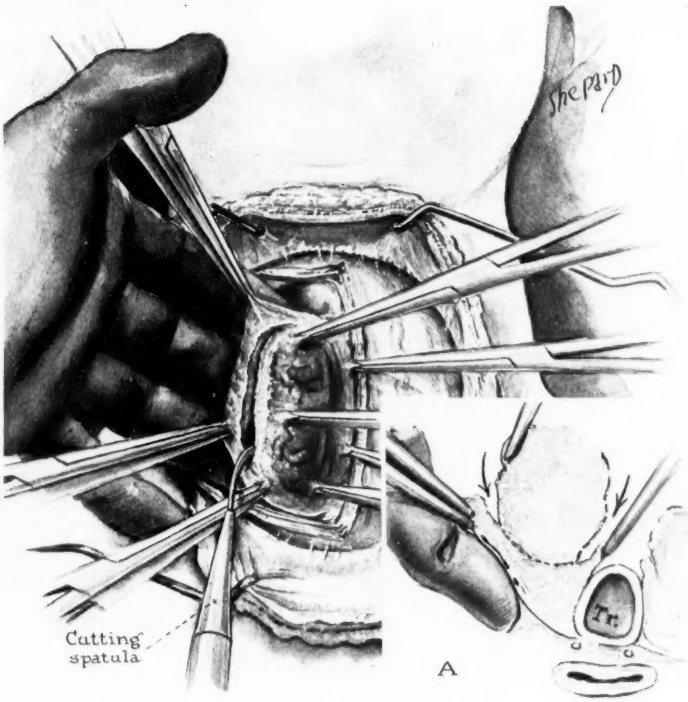


Fig. 2.

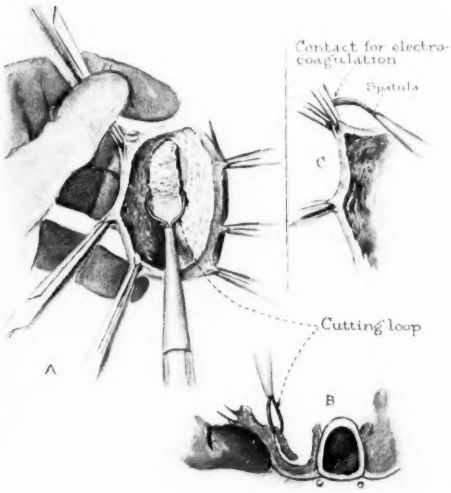


Fig. 3.

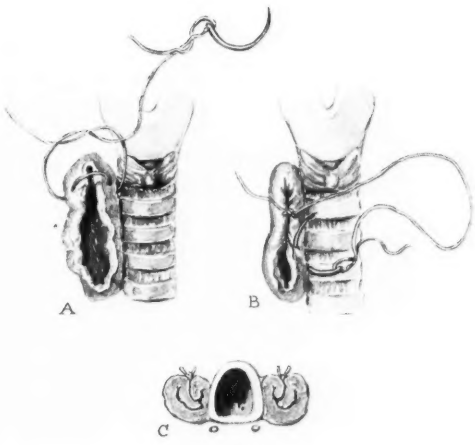


Fig. 4.

(Legends on opposite page.)

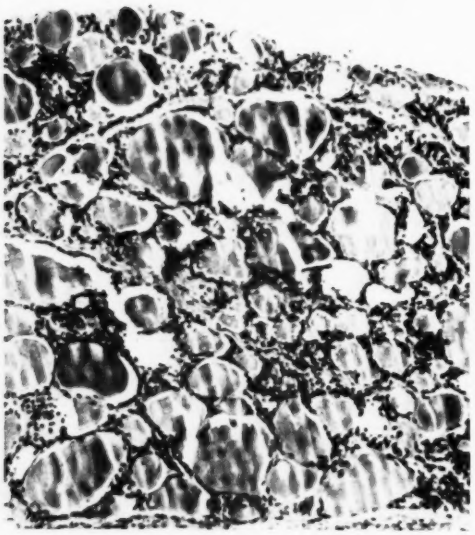


Fig. 5. Shows photomicrograph of surface of goiter cut by knife.

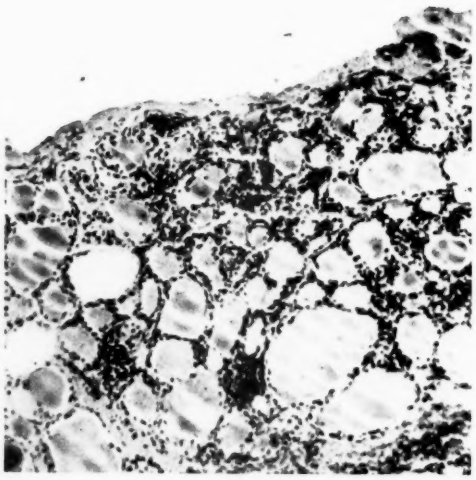


Fig. 6. Shows photomicrograph of goiter cut electrically. It will be noted that the surface destruction is slight but the electric current gives sufficient coagulation to prevent all oozing and bleeding from smaller vessels.

amount of tissue to prevent hypothyroidism, more is left than is necessary and hyperthyroidism recurs. To avoid this possibility I ordinarily remove excess of tissue with a loop and slow cutting current. It is possible in this way to save a thin shell of thyroid tissue on the outside of the gland where the main blood supply is almost entirely located. The inside of the goiter can thus be removed much as we peel the pulp of an orange out of its skin, leaving that portion which is in close relation to the parathyroid glands, the recurrent laryngeal nerve, and the main blood vessels. Conservation of the main blood supply insures an adequate circulation for the portion of tissue which is left.

It is now possible to obtain an electrical outfit which does satisfactory work and is not so complicated as to require the constant attention of an assistant. Appliances are available, the holders of which are about the size and shape of a pen holder. All of us are accustomed to use a pen and can use such an instrument much more skillfully than the more cumbersome pistol grip or holder with a switch in the handle which requires constant pressure and interferes with the delicacy of manipulation. There also seems to be hope that an efficient electrosurgical outfit may soon be available at a cost within the reach of most hospitals and surgeons rather than at the prohibitive prices which have prevailed.

Electrosurgical outfits have been used by a number of outstanding surgeons in this country for a good many years, especially in the management of malignancy. Their advantages have become apparent to many members of the profession and I believe that shortly an electrosurgical unit will be considered a necessary part of the equipment of every modern operating room, especially where much goiter surgery is done.

PRACTICAL EXPERIENCES IN ELECTROSURGERY[1]

OSCAR E. NADEAU, M.D., F.A.C.S., CHICAGO

IMPROVEMENTS in the manufacturing of electrical equipment in the last few years have greatly stimulated the use of electricity in general surgery. With a well regulated and reliable instrument, one is more prone to try a newer method in the hope of improving his technique.

We must not forget, however, that electrosurgery is a powerful and even dangerous medium, unless handled properly. The opposite electrode should have a wide surface well applied to the skin of the buttock or thigh, in order not to burn the patient at this location. Likewise, the cautery knife should not be allowed to injure the arms of assistants or to fall off the sterile table, upon the patient. A slip of the cautery knife can do more harm than the slip of a scalpel. However, with ordinary care and with a staff well trained, none of these accidents need happen.

Our experience with cautery in surgery dates back to about 1900, when our late chief, Dr. A. J. Ochsner, first began to treat malignancies of the face with soldering irons. A few years later, Dr. Ochsner used an electrically heated platinum knife in the removal of cancers of the breast and in epitheliomata.

In our clinic at the Augustana Hospital, we have used, since 1926, electrosurgical units based on radio frequency. The method was first used in treating cancer of the breast and has since been utilized, either exclusively or as an adjunct, for the following purposes: (1) to remove malignant disease surgically, (2) to produce coagulation, (3) to treat infections, (4) to reduce hæmorrhage from cut surfaces, and (5) to sterilize cut surfaces.

It is in the surgical removal of malignant disease that this method has its greatest advantage. In removal of epitheliomata of the face or elsewhere, of warts and moles, and in carcinoma about the face, jaws, and lips the searing of cut surfaces with the electric current probably has prevented many recurrences which would have followed the use of the scalpel. In this class of cases the electrocautery knife is used exclusively and in all instances. The edges of the wound are approximated by sutures in the usual manner wherever possible. When approximation is not possible, good granulation for skin grafting later is always found in a wound that has been made by cauterization.

The cautery knife has been used in our clinic more in removal of carcinoma of the breast than in any other surgical condition. The electrode is used during the entire operation and with the current of highest intensity, so as to produce rapid cutting. When cleaning the axilla, however, and in manipulations about the axillary vessels and nerves, we are still using the gauze sponge for stripping fat and fascia from these structures. This is probably a little safer because of the very close proximity of thin walled vessels. After the operation, we have been in the habit of excising about 1/8 inch of the skin margin with a scissors, thereby removing the entire edge of the wound. Our reason for this is that in a few cases of operation by cautery, the skin edges have not healed quite so kindly following the cautery as they do with ordinary scalpel-made wounds. It may be that by using a current of higher intensity, this edge may be cut so sharply and with so little distant burning that the wound may be closed by sutures in the ordinary manner. It is too early as yet to know the ultimate results in cancer of the breast treated by electrocautery as compared with excision with a scalpel as in the past. There are so many factors in determining end-results in breast amputation for carcinoma, that statistics as used in the ordinary sense are of little benefit. For instance, there is a great difference in prognosis in cases with axillary metastases as contrasted with those who have no metastases.

In cases of carcinoma of the cervix where surgical operation is indicated, the electro-knife is again of very great benefit, chiefly in the technique of the operation. With a well insulated handle to the knife, one can work deep in the vagina in a field that is relatively bloodless. Then, after the removal of the main body of the tumor, if any remaining masses are seen, they may be cauterized down to normal tissue with the same electrode. We have operated upon many patients with cancer of the cervix by this method and would never wish to return to the old scalpel method.

Besides excision of tissue as described, the electric current has another distinct advantage, that of coagulation. With a special coagulating current that is available in modern apparatus, one may control the amount of current to such an extent as to produce any depth of coagulation desired. In the treatment of hæmorrhoids by

[1]Presented in the Conference on Electrosurgery, before the Clinical Congress of the American College of Surgeons, Philadelphia, October 13–17, 1930.

clamp and cautery, a low coagulation current gives the same result as the use of hot irons as used in the past. It can be handled more easily, however, because one has the same intensity at all times and there is no cooling of the electrode while working. In the control of oozing, bleeding surfaces, such as in breast amputations and other massive operations, the simple touching of bleeding points with the electrode immediately stops bleeding. One should be careful here not to produce too much cooking of the tissues or there will be sloughing and a wound that drains for several days afterward. To some extent, ligatures are being replaced by electrocoagulation. Forceps are used in the usual manner, but instead of applying a catgut ligature the electrode is applied to the forcep, thereby coagulating the vessels caught by the end of the forcep. Experience is required in knowing just how long to allow the cauterization to go on. With a well trained staff it is thought that this method of controlling hæmorrhage may ultimately at least partially replace the use of ligatures.

In the treatment of infections by cautery, there may be many uses in which this method may be applied. We have applied cautery in only one class of infections and have had very good results. In chronic, cystic endocervicitis, where there are many mucous or pyogenic cysts and where in the past a complete excision by knife was the rule, we have replaced excision of the cervix by multiple sieve cautery of all portions of the cervix. Each cyst is punctured individually and the cauterization may be extended as deep into the cervix or into the uterine cavity as desired. Chronic discharges from this disease have been relieved to a far greater extent by this method than by that of surgical excision.

The electrocautery knife has the advantage of not only cutting but also of reducing hæmorrhage in the cut surface. There are many instances where this is highly advantageous. In the secondary stage in the operation for œsophageal diverticulum where the sac is to be cut off, this can be done very nicely with the electro-knife. Similarly, in opening a colostomy and in gastric and intestinal surgery anywhere, when it is necessary to cut through or across a bowel, we believe that the cutting current should be of much less intensity, the lowest cutting current being used for this purpose. Where clamps are used in bowel surgery, they may be applied much more lightly when this method is used.

When bowels are sectioned there is not only a reduction of hæmorrhage but also an actual sterilization of the cut surface. The current is of sufficient intensity to make a perfectly sterile field resultant after cutting across the bowel. In this way, in operating upon the stomach or the intestines, one may have aseptic technique from beginning to end of the operation. This applies also to the ordinary technique of an appendectomy and will replace the use of phenol or other chemical reagents as used at present.

Anæsthesia is an important factor in the use of high frequency current producing sparks about the operating field. It necessarily means there can be no highly explosive gas in the room in sufficient concentration to produce possible explosion. It means that ethylene cannot be used as an anæsthetic, ether only occasionally. Therefore, the most satisfactory will be that of conduction anæsthesia, such as in the spine, or block or infiltration anæsthesia with novocain. Nitrous oxide is, of course, a safe gas anæsthesia to use with cautery.

SUMMARY

The electrosurgical unit in its present state of development is a distinct advance in modern surgical technique. New indications are being found every day. It is a new method, the details of which must be thoroughly familiar, not only to the surgeon, but to the entire staff of assistants and nurses.

THE ELECTROSURGICAL UNIT AS AN AID IN GENERAL SURGERY[1]

HOWARD LILIENTHAL, M.D., F.A.C.S., NEW YORK

SOME years ago I first employed the electric method for removing a section of giant fibrosarcoma of the pleura through a previously existing wound. The tumor was a very large one and I intended to take away as much as I safely could. At that time the apparatus at my disposal was fitted with an ordinary steel needle which was used as the cutting-electrode. It functioned slowly, the needle soon became oxidized and had to be frequently replaced. Finally I gave it up and completed the operation with knife and curette. A few months ago I was supplied with another apparatus and was requested to test it on a piece of beef. I was amazed at the facility and accuracy with which the muscle and fibrous tissues were divided. Then, too, the suggested hæmostasis by coagulation seemed desirable. One merely caught the spurting vessel and touched the clamp with the coagulating electrode. At once the tissue held by the clamp was desiccated.

Although I had previously understood that the principal use of electrosurgery was for the removal of malignant tissue, I was encouraged to employ the method in general surgical procedures. My first case was one of extrapleural apicolysis with the approach through the axilla. The chest of this patient was well covered with adipose tissue. The incision to the bony chest wall, about 6 inches long and 2½ inches deep, was made with the greatest ease, and the hæmostasis in this rather vascular region was extremely satisfactory. As the apex of the lung had been compressed after rib resection by the ordinary method, the entire wound was packed with rubber dam and the skin closed with temporary sutures to be removed in 4 days. At the end of this period the cutaneous edges were in firm primary adhesion. There was no infection and there had been no bleeding. The packing of rubber was now removed and replaced, and this was repeated every day thereafter. Under these circumstances a certain degree of secondary infection was unavoidable, but there was no bleeding, and granulation proceeded normally.

My second case was one of femoral hernia operated upon by the lower abdominal route. The plastic work about the femoral ring was done with ordinary surgical instruments. Strong and quick primary union followed.

Another hernia was a difficult, recurrent, inguinal one, and there was much scar tissue. This was excised, the field was cleared by electrosurgery, and the deep repair was made by the usual means. I considered this a rather severe test and am glad to report that healing was rapid and secure.

I have had several cases of chest wall operations, including chronic empyema and paravertebral thoracoplasty for tuberculosis. The notable feature in these, as in all my cases, was the saving of time and the perfection of hæmostasis. Manifestly the electric method does not lend itself to sections of rib or other bony structures.

I have operated in three mammary cases, two of which were local tumors. The third was a recurrent carcinoma in which the patient had refused a radical operation and consented only to an extirpation of the recurrent mass. It was necessary, however, to remove a considerable portion of the breast and underlying pectoral fascia and muscle. The operation went very smoothly and with the usual satisfactory hæmostasis and consequent saving in time. There was healing without complication. In one of my other cases, the removal of a recurrent nodule after an extensive radical operation, there was retention of bloody serum in the cavity left by the excision of the growth. The walls of the remaining cavity could not be firmly approximated. This necessitated the insertion of a small drain, but I do not ascribe the condition to the electrosurgery because it is frequent enough in such cases when the more usual methods are employed.

There are two abdominal cases, one an appendicectomy in which the abdominal wall was extremely adipose so that the wound was fully 2½ inches deep before the aponeurosis was reached. Electrosurgery was used down to, but not through, the peritoneum. The result was perfect primary union. The other laparotomy was for exploration of the gall bladder and division of adhesions. Through a second incision a diseased appendix was removed. This man also had an extremely fat abdomen. There was primary union of both wounds. The patient, however, a large, powerful individual, developed massive collapse of the right lung immediately after the operation and, probably because of spasmodic cough, the lips of the cutaneous wounds separated after the skin clips had been removed. There was no infection, however, and final healing was unimpeded and perfect.

From the experience with these cases I have come to the following conclusions:

[1]Presented in the Conference on Electrosurgery, before the Clinical Congress of the American College of Surgeons, Philadelphia, October 13–17, 1930.

1. The electric method under discussion promises to be a great aid in general surgery.

2. The tendency to wound infection is definitely reduced.

3. Hæmostasis is quick and sure. In my small series of cases there has been no recurrent or secondary bleeding.

4. Healing has been normal in rate and in firmness. The time is too short to have formed conclusions as to keloid. Thus far I have not observed this condition.

5. When local anæsthetics were employed, my impression is that there may have been electric subjective reactions of pain and that the pain or discomfort was more than when the scalpel was used. On dividing muscle there has been more twitching than is ordinarily seen on knife section.

6. The apparatus must be properly managed. Its liability to get out of order or to diminution of functioning power may have to be considered. Thus far I have not noted deterioration of this kind.

It seems to me that the electric method is extremely valuable in general surgery and that the wounds are more likely to be aseptic than those in which the scalpel is used.

In this discussion I have not dealt with the technical part of electrosurgery. There is danger of producing accidental burns by contact of the electrode with metallic bodies in the wound, such as metal retractors or artery clamps.

I believe that the principal use of the new method in general surgery will be for making incisions through the soft parts, including the skin and, of course, in the removal of lesions outside of the body cavities.

The action of the electrode on the tissues seems to be that of intense heat; but the intensity is so great that with the cutting motion there is rapid linear disintegration of tissue with minimum charring or coagulation. A cautery blade of the ordinary type loses its heat by contact with the tissues, so that coagulation is more massive and the knife sticks to the surfaces of the wound. With the electric scalpel, on the contrary, the wound is clean cut and, except for the absence of bleeding, its edges in skin incisions resemble those made with the sharp knife.

Skin, fat, and muscle are divided without apparent effort by the operator, and denser structures such as fibrous tissue may also be sectioned but more slowly.

Capillary oozing is practically absent. With the rapid current which I have used in my operations, there is bleeding from many of the smaller as well as the larger vessels when they are divided, but this depends, of course, on other things than the mere division of the vessel, e.g. the coagulability of the blood and the elasticity of the vascular walls as well as the hydrostatic pressure in their lumen. All bleeding points are caught with forceps. Whether a vessel needs to be ligated or whether it may be permanently sealed by touching the clamp with the coagulating electrode can be determined only by experience. As a rule, however, a small spurting vessel which has been sealed should not bleed on lightly sponging the wound. If there is any doubt, ligation should be done as in ordinary surgical procedure. In any event, I believe it is safest to deal individually with wounds of the vessels. Secondary hæmorrhage in the absence of suppuration is no more likely to occur after an electrically made wound than after an incised one. I confess to an insufficient experience to generalize too certainly in this matter, although in some of my cases the wounds have been very extensive.

When there has been neat approximation, primary union may be confidently expected. I feel, however, that in the electrically produced wound the presence of a thick adipose layer tends, perhaps, to prolong solid union. This is, of course, not necessarily the fault of the electric technique, for slow healing in fat subjects is never surprising. Broad approximation of wound surfaces and an interval of a day or two longer before removing sutures is advised.

The electric scalpel cuts so keenly and with so little pressure on the tissues that great care must be taken not to go deeper than is intended. For example, in dividing the abdominal wall the peritoneum should be entered in the usual way with knife or scissors for fear of injuring the viscera by the current. In the region of large vessels or of important nerves, the greatest delicacy of manipulation must be observed.

The outstanding features of electrosurgery are the saving of time, the greater assurance of asepsis, and the reduction of what may be called the massage effect, so dangerous in operating through infected or neoplastic structures.

ELECTROSURGERY IN DISEASES OF THE GENITO-URINARY SYSTEM[1]

EDWARD L. KEYES, M.D., F.A.C.S., NEW YORK

I HAVE been unable to control the electrocautery knife adequately for my surgical needs. Like many other surgeons, habit has given me a tactile sense at the end of my scalpel. Such fineness as is achieved in dissection is evidently due in large part to this educated tactile sense. The electric knife however divides all tissues with equal facility (if one except bone and cartilage) and one feels lost without the familiar unequal resistance of the various soft tissues. Doubtless a greater experience might alter this opinion of mine and I can have no objection to the electrosurgery of a younger generation if its tactile sense is not thereby impaired. No doubt my father would have protested in his day that the rubber glove destroyed his tactile sense.

The most important application of electrosurgery to urology has been in the operation for bladder tumor. I have opened the abdominal wall and the bladder a few times with the electrocautery but almost all of my operations have been performed with the scalpel. I do not recall any implantations of tumor in the suprapubic wound. It is possible by meticulous care and notably by clamping pads to the edge of the bladder wound, much as towels are clamped to the edge of a peritoneal wound, to keep the wound from contact with tumor tissue.

The actual attack upon the tumor by electrocautery is quite another matter. The electrocautery is by far the most convenient method for destroying small multiple tumors of the bladder. With this instrument alone the bladder in which as many as 30 or 40 such tumors are growing, can be entirely rid of them.

The attack upon larger tumors of the bladder and notably upon infiltrating tumors is made by some with the electrocautery, by some with other forms of cautery, and by some with radium—not to mention resection of the bladder and complete cystectomy. My vote goes for radium emanation seeds. It is my belief that the implanted emanation seeks out unsuspected islets of tumor tissue more intelligently than the surgeon can. Clinical experience each year leaves me more devoted to this method of treating bladder tumors. On the other hand, the actual excision of masses of bladder tumors can often be most conveniently performed by the electric knife so that the pedicle of the tumor can be exposed and implanted with radium emanation.

The electrocautery knife employed by Collings and others to attack the bladder neck and relieve minor obstructions has a distinct place in the armamentarium of the specialist, though it has not yet been proved which of the various operations for relief of obstruction due to prostatic sclerosis is preferable. I do not mention my own preference since it is not fixed and would have no weight against the fixed habits of the urologist to whom the general surgeon would be wise to refer such cases.

Externally the electric knife has many uses. It is an excellent instrument with which to ream out wee sinuses from the bladder or urethra since it should destroy the mucous membrane and thus eliminate the gaping entry to the wound through which the urine pours and keeps the sinus open.

The electric knife is the weapon to be preferred for performing circumcision or the so-called bilateral slit whereby the preputial cavity is opened up to expose a chancroid within.

And, finally, it is doubtless well known that electrocauterization is the preferable destructive agent for cysts, papillomata, and granulomata, whether of the skin, of the preputial cavity, or of the urethra. It is equally to be preferred as the convenient agent for attacking obstinate and phagedenic chancroids, as well as granuloma inguinalis which does not yield promptly or completely to antimony.

[1]Presented in the Conference on Electrosurgery, before the Clinical Congress of the American College of Surgeons, Philadelphia, October 13–17, 1930.

ATTEMPTS TO EXPRESS MATHEMATICALLY THE HEALING OF ELECTROSURGICAL WOUNDS[1]

JOHN D. ELLIS, M.D., CHICAGO
From the Department of Physiology and Department of Experimental Surgery, Northwestern University Medical School.

THE use of electrosurgery, at the present stage of its development, is an art, and, unfortunately for the purposes of the exact scientist, does not lend itself readily to exact study. Careful investigation is being undertaken to determine the exact characteristics of the currents which produce the optimum effects desirable in surgery, i.e., electrocutting, electrodesiccation, and electrocoagulation. These three tissue effects depend quite obviously on variation in the amperage, voltage, frequency of oscillation, length of time applied, and, perhaps, on the degree of damping. There is no question that these three separate effects can be demonstrated histologically.

Electrocutting can be described as producing sudden explosive reactions liberating the fluids from individual cells which are destroyed in the process. Electrodesiccation or dehydration does not coagulate, but simply shrivels the tissues, while the cell contours remain distinguishable and the capillaries are closed by the shrinkage. Clinically, some dehydration is combined with the cutting effect to control capillary hæmorrhage. Electrocoagulation depends on a thermal effect more rapidly applied than desiccation. This was formerly called "surgical diathermy." It is with the problem of wound healing in electrocutting that we have been interested.

Alexis Carrel (1) has recently said that the process of wound healing appears to him the most fundamental problem in surgery today. The healing of electrosurgical wounds is an important part of this problem. There is no question that the obvious advantages of the newer types of electrosurgical knives has aroused the interest of the entire surgical profession, and that everyone wants to know to what extent these currents can be relied upon for general surgical use, as well as for special indications of the resection of malignancies and other operations in which a rapid control of capillary hæmorrhage is desirable. It is for these special indications that electrosurgery has been advised and successfully used by a very few operators in the past. As in many other innovations in surgical technique which have been instigated, the acceptance of this method by general surgeons has been delayed more by the enthusiasm of its optimistic friends than by the pessimism of its enemies.

Latterly we find a growing literature in which the impression is broadcast that healing after incisions with a cutting current is just as prompt and satisfactory as after the use of the ordinary scalpel. We have attempted to compare mathematically the use of cutting currents with the use of the scalpel. Much of this work has already been accepted for publication elsewhere (4), and we can give only a brief summary of this investigation here.

Two plans for reducing the expectancy of wound closure to mathematical expression have been devised. The first, with which we are all in a general way familiar, is the study of the rate of diminution of surface wounds involving a loss of substance. Since Carrel (2), in 1910, saw the possibility of establishing a formula expressing the expectancy of wound healing, du Noüy (3), working with Carrel, actually established such a formula. Spain and Loeb (6) corroborated this in all the important aspects. The other plan was devised by Howes, Sooy, and Harvey (5) who determined the tensile strength, at various time intervals, of healing wounds in different tissues. Incisions were made with a scalpel, and centimeter length specimens of these wounds were pulled apart and the tensile strength recorded in grams.

We decided to test the tensile strength of electrically produced wounds in the skin, muscles, and stomach, in comparison with similar wounds produced by the scalpel, with the purpose of ascertaining: (1) the frequency with which primary union occurred in these tissues after electric surgery; (2) the rate at which strong cicatrization of the electrically produced wounds developed; (3) the relative time which is necessary for the development of the maximum tensile strength of the electrically produced wound as compared with the knife wounds.

Our results present a large gross error, as one would expect in dealing with the healing of wounds in experimental animals. The operations were performed on a fairly large series of dogs, 120 being used in these experiments, 66 in the skin and muscle operations, and 54 in the stomach experiments. This reduces the range of experimental error to a point where our control experiments with the scalpel correspond with fair accuracy to the results obtained by Howes, Sooy, and Harvey,

[1] Presented in the Conference on Electrosurgery, before the Clinical Congress of the American College of Surgeons, Philadelphia, October 13–17, 1930.

and our results with the electrosurgical knife present no larger variation than those with the scalpel.

Skin operations will be considered first. Two types of current were used: first, the cutting current with very slight desiccating effect (that is, just enough to cause a sufficient desiccation of the cut edges of the dog's skin to control capillary hæmorrhage); and second, a cutting current with a heavier dehydrating effect (approximately the amount of desiccation produced when the cutting current is employed on human skin. In the wounds produced with the electric knife, 60 per cent showed primary union, while 40 per cent were still ununited on the twenty-second day. In comparison with this, 97½ per cent of the knife wounds healed by primary intention. This shows the inadvisability of expecting to obtain primary union uniformly in electrically produced incisions in the skin. In the curves representing the tensile strength of the wounds produced in the skin, the middle values of the cutting currents are particularly weak, showing 100 to 150 grams less strength than the knife wounds. The wounds produced with the cutting current and the minimum desiccating effect show a strength equal to a scalpel wound on the twenty-first day, whereas when the heavier desiccation was used, the electrically produced wound still remained slightly weaker on the twenty-first day than the scalpel wound. It is understood that these values in strength of healing represent only 40 per cent of the electrically produced wounds and 97½ per cent of the knife wounds.

The sartorius muscle of the dog was sectioned transversely on one limb with the cutting current, and on the other with a knife. These wounds were sutured and on various days the dogs were killed and the muscles removed for testing the strength of healing. The curves of healing show that for practical purposes healing occurs as rapidly and with as great strength of union in the electrically produced wounds as in the knife wounds of muscle.

Victor Pauchet reports that he has been able to perform gastro-enterostomies quite successfully with a cutting current, using a single layer of sutures to close the wound. Of our 54 stomach operations on dogs, 2 developed peritonitis. The remainder all showed primary healing with the electric knife as well as the scalpel, and the curves plotted in this experiment show a satisfactory speed in development of tensile strength in electrically produced wounds, although there is a mid period when they are not so strong as scalpel wounds. A single layer of sutures was used to close the wounds. This mid period is not the time at which complications develop in stomach surgery, and so the lack of tensile strength at this period seems not very important. Unfortunately, in operations on the human considerably more desiccating effect must be exhibited in the current than that used on a dog's stomach. This consideration may result in a greater retardation in healing than we experienced with animals.

SUMMARY

1. Only 60 per cent of electrocutting skin wounds in dogs, where the minimum of current was used, healed by primary intention, as compared to 97½ per cent of scalpel wounds.

2. This 60 per cent which healed did not present a tensile strength equal to the scalpel wounds for 21 days.

3. Incisions of the stomach and muscle with the electric knife present a much more satisfactory percentage of union and strength of cicatrization comparable to the wounds with the scalpel, except that the electro-cutting wounds of the stomach were notably weaker at the midpoint of healing.

REFERENCES

1. Carrel, A. The process of wound healing. Proc. Inst. Med. Chicago, 1930, viii, 62.
2. Idem. The treatment of wounds. J. Am. M. Ass., 1910, lv, 2148.
3. du Noüy, P. L. General equation for law of cicatrization of wounds; latent period. J. Exper. Med., 1921, xxxiv, 339.
4. Ellis, J. D. The rate of healing of electrosurgical wounds as expressed by tensile strength. J. Am. M. Ass., 1931, xcvi, 16-18.
5. Howes, E. L., Sooy, J. W., and Harvey, S. C. The healing of wounds as determined by their tensile strength. J. Am. M. Ass., 1929, xcii, 42–45.
6. Spain, K. C., and Loeb, Leo. Wound healing. J Exper. Med., 1916, xxiii, 107.

ELECTROSURGERY IN THE TREATMENT OF MALIGNANT DISEASE[1]

A. C. SCOTT, M.D., F.A.C.S., TEMPLE, TEXAS

IF one accepts as a fact that cancer cells are transplantable, there is no escape from the further fact that when a surgeon's scalpel cuts into cancerous tissue and passes into neighboring healthy tissues there is considerable danger of contaminating the wound with cancer cells which may be responsible for local recurrence of the disease long after the wound has completely healed. During block dissections of lymph-bearing fat containing cancerous lymph nodes, if such nodes are incised with the scalpel or mashed with gauze sponges while being dissected or torn from large vessels and nerve trunks one cannot imagine a more likely means of spreading cancer cells upon tissues which give every opportunity for reproduction of the disease which the operation was designed to remove.

These facts constitute the soundest reasons for substitution of hot instruments in some form for the scalpel and blunt gauze dissections commonly used in the surgical removal of malignant masses and nodes.

No well informed person doubts for a moment that the surgical removal of malignant disease has given by far the highest percentage of permanent cures, but the large number of local recurrences after surgical removal with the scalpel furnishes abundant evidence that surgeons fail too frequently to make excisions wide enough to include all the diseased tissue or that they leave the wound contaminated with cancer cells, either of which may result in local recurrence and failure to cure.

Heat is the most potent destructive agent known to man; and since electricity has come under man's control, heat has become the most controllable of all powerful agents which are subject to our use.

Heat from an electric current may be made usable in one of three ways or by one of three distinctly different devices: One has been described as the diathermy or radio knife and for its operation depends upon passage of an electric current through the patient's body. Another electrocautery device, exemplified in the well known Percy cautery, slowly heats a cautery tip by radiation from a central core. The third device consists of a loop of resistant metal preferably flattened and beveled at the edge, attached to an appropriate handle and connected to a transformer rheostat. The passage of an electrical current creates instant and controllable heat in the loop, which is used by direct application to the tissues in a manner similar to the use of a scalpel. This device is the loop cautery knife and is popularly referred to as the Downes cautery.

The first device, the radio knife, is as light and wieldy as a fountain pen. However owing to the uncontrollability of the direction of the current within the tissues and beyond its point of contact, in major surgical operations it is not free from some of the dangers which have not been observed with the use of those cautery devices which eliminate the patient from the electric circuit. I cannot detail them here.

I have found it possible to control the heat from the loop cautery knife, especially in cleaning fat and fascia from large blood vessels and nerve trunks, and I have rarely seen shock follow its use. Since no electric current passes from the loop cautery knife to the patient's body, the conductivity of the large vessels and nerves have no attraction for it. On account of the cooling effect of the rapidly moving blood current within large blood vessels, their walls are much more resistant to heat than one would imagine. This permits passing of the low-temperature loop cautery within a paper's thickness of their walls without harm. If a surgeon loses his bearings and touches a large vessel with the cautery, a perforation, particularly if a vein is touched, will occur, but it may be interesting to those who have not had much experience with perforations of large vessels to know that such perforations are not usually serious and are much more easily and safely repaired than are perforations of the intestines.

Some reservations should be made concerning my observations of the radio knife as I have done with it only 10 major operations which required block dissections. Two of these were for cancer of the face and neck and 8 were breast amputations with block dissections of the axilla; whereas my observations with the loop cautery knife cover 309 block dissections, 210 of which were breast amputations with block dissections of the axilla.

Contrary to common knowledge concerning the use of the hot cautery in the surgical treatment of malignancies, the loop cautery knife, when properly used, makes possible a complete, classical surgical operation, practically eliminating contamination with cancer cells, without charring the

[1]Presented in the Conference on Electrosurgery, before the Clinical Congress of the American College of Surgeons, Philadelphia, October 13–17, 1930.

tissues or otherwise interfering with primary healing of the wound. Its use does not result in agonizing pain and shock, as occasionally observed after the use of the slow cautery destruction of tissues, exemplified in the soldering iron or similar instruments of slow destruction.

Assuming that the surgeon does not puncture malignant diseased tissues with needles or incise them with a scalpel, as is frequently done for diagnostic purposes, and does not produce unwarranted trauma by rough manipulation of the tumor mass or diseased lymph nodes during examination or operation, he is in no way responsible for remote metastases which render cure impossible. Therefore, cancer statistics aimed at determining the value of any surgical procedure are sure to be misleading unless limited entirely to the question of local recurrence of the disease in the operative field.

In the last analysis, the presence or absence of local recurrence of malignancy in or near the operative field is the principal incident worth considering in statistical calculations designed to determine the relative value of any surgical procedure directed at the eradication of malignancy.

Observation in the use of the loop cautery knife in more than 1500 operations for malignancy leaves us with no other alternative than the conclusion that at present it is the safest and most dependable means of eliminating local recurrence of malignancy after major surgical removal.

SOME PHASES OF ELECTROSURGERY FROM AN EXPERIMENTAL STANDPOINT[1]

H. F. PIERCE, PH.D., BALTIMORE, MARYLAND

MEDICAL men are notoriously shy of apparatus which involves the use of electricity, due, no doubt, to the apparent complication of control of many of the instruments offered to the profession. The designers of such apparatus, skilled in the use of electrical devices, rarely place themselves in the position of the surgeon, who desires an instrument, not for its technical excellence, but as a means to an end. The ideal instrument should be as simple to use as the telephone which stands on the surgeon's desk, and should require, on the surgeon's part, no more knowledge of the intricacies of its mechanism.

The instrument makers of this country have done excellent work during the past few years, in the development of electrosurgical apparatus, and within a short time they may be able to present us with perfected equipment for our purpose.

In the present state of our knowledge, we may say that the ideal electrosurgical apparatus should have the following characteristics:

It should have not more than three controls: (1) a selector switch, with a vertical handle which may be covered easily with a sterile cap, for setting the instrument for cutting, desiccation, or coagulation, as required; (2) a sterilizable control handle, to vary the current from zero to maximum, on any one of the above mentioned modalities; (3) a foot-switch, to turn the current on and off quickly.

It should have fineness of control. The control handle should raise the current strength from zero to maximum smoothly and continuously, without jump or break, to avoid faradism with contraction of the muscles and possible discomfort to the patient. For work on fine tissues, such as those of the orbit, this is essential.

It should be safe. The electrical circuits should be so arranged as to prevent grounding of the current, of either low or high voltage, through the patient's body or that of the operator. The apparatus should be grounded, to prevent corona, which though not dangerous may be disconcerting.

It should eliminate low frequency currents. The apparatus should be so designed as to eliminate low frequency current, or harmonics of low frequency, from the patient's circuit, so that there shall be no stimulation and contraction of muscle fibers. This is particularly important in working with fine tissues, or in close quarters, where muscular contraction might bring sound tissues into the field and expose them to damage.

It should be adaptable for diathermy treatment. With little effort and expense this apparatus could be made to furnish diathermy current sufficient for treatment of small areas such as the eye or the knee-joint.

In learning to use the electrosurgical apparatus the surgeon may well begin by experimenting on

[1]Presented in the Conference on Electrosurgery, before the Clinical Congress of the American College of Surgeons, Philadelphia, October 13–17, 1930.

butchers' meat, but for the assurance of successful results in his practice it is imperative that he make his preliminary tests and perfect his technique on living animals, before attempting to employ the instrument and method in the operating theater.

SOME PHASES OF ELECTROSURGERY FROM THE EXPERIMENTAL STANDPOINT[1]

A. L. MacLEAN, M.D., Baltimore, Maryland

WORKING in conjunction with Dr. Pierce I performed a number of operations and experiments with the electrosurgical unit on the lids, eyes, and orbits of rabbits. From these experiments we concluded that in its present state it is not adapted for ophthalmic surgery except in a limited number of cases. I feel certain that there is no operation we perform on the human eyeball itself that could be attempted safely with the present instrument. It is entirely too destructive and dangerous. Unless the eyeball itself, and particularly the cornea, is well protected from the electric spark, shock and danger of a severe burn may result.

The coagulating current, however, is very useful for checking excessive hæmorrhage after an evisceration operation, where the eyeball and all other contents of the orbit have to be removed because of an infiltrating and spreading malignant growth. In some of these cases of evisceration the electric cautery is inadequate to cope with the situation.

The desiccation current can be used to remove small moles, etc., from the skin of the lids, but great care must always be taken to protect the eyeball and particularly the cornea from the electric spark.

There are a number of operations in ophthalmic surgery where the electric cautery is used ordinarily, e.g., in certain types of entropion cautery punctures are made below the lid margin, going through the skin and subcutaneous tissue in order to produce scar contracture after healing, and thus draw the lid margin outward. The cautery is also used on the eyeball itself in the Gonin operation for detached retina, except that Gonin uses a Paquelin cautery. At present the electrosurgical instrument cannot replace the cautery in any of these instances.

In conclusion, the chief objections to its use in ophthalmic surgery are: first, the great danger of serious injury to the eyeball; second, too much twitching of the muscles caused by electrical stimulation; third, its destructiveness. For plastic work too much useful tissue is lost.

The delicate fine electrodes, easily adjustable, are an advantage in such a small operative field as the orbit and lids, and we feel that the instrument has possibilities for our type of work if some of its present objectionable features are removed.

[1]Presented in the Conference on Electrosurgery, before the Clinical Congress of the American College of Surgeons, Philadelphia, October 13–17, 1930.

REPORT ON RESEARCH ON ELECTROSURGERY[1]

BOWMAN C. CROWELL, M.D., CHICAGO
Director of Clinical Research, American College of Surgeons

DURING the past few months a co-operative research has been initiated under the auspices of the Department of Clinical Research of the American College of Surgeons in an attempt to ascertain the value and fields of usefulness of electrical cutting and coagulating instruments in general surgery and the surgical specialties. To date 196 surgeons from 33 states have furnished individual reports on their experience with the instruments in 913 cases. It is upon a study of these reports that the present study has been based. The individual surgeons have reported upon the use of the electrosurgical unit in from 1 to 82 cases. In some cases the unit has been used as an adjunct and in some cases as the sole surgical instrument in such conditions as abscess, actinomycosis, blastomycosis, benign tumors, malignant tumors, ulcers, polyps, cysts, lacerations, amputations, carbuncles, and condylomata in practically all organs of the body. The anæsthetics used have been local, spinal, ether, nitrous oxide, chloroform, sodium amytal, avertin, and ethylene. The last has been used in 15 cases on operations of the cervix, bladder, and breast.

In the overwhelming majority of the reports as to postoperative pain, the statement is made that this is not increased in amount and is more frequently less than after the use of the scalpel.

The occurrence of secondary abscesses following operation has been an almost negligible feature being less frequent than is usual in other procedures.

The time of wound healing has been delayed in the hands of a few of the surgeons. This appears to be especially true in healing of the skin.

Slight secondary hæmorrhage is mentioned in a few cases, but in none of these is it mentioned as being the important element. Its incidence is not prominently associated with any one organ or lesion.

The surgeons were asked to comment on the advantages and disadvantages of the electrosurgical method in each case treated. Some of the advantages are apparently real in some cases, and in others the advantages claimed must be explained as hopefulness on the part of the surgeon. In the latter group come cases of cancer in which the sealing of the lymph and blood spaces is referred to as preventing the dissemination of malignant cells. It is obvious that only time can settle this question.

Among the more prominent advantages claimed for the method are the rapidity of operation owing to the lessened hæmorrhage and obviating the necessity of ligaturing blood vessels. Hæmostasis is the advantage which has attracted the attention of the great majority of the surgeons. The fact that ligatures need not be left in the depth of the wound as a foreign body has received favorable comment. Lessened oozing of serum into the depth of the wound has also been found a distinct advantage.

Among the disadvantages mentioned have been burns at the points of contact and delayed healing of skin edge owing to excessive coagulation of the skin. This has been obviated by some surgeons by using the scalpel for skin incision and by others by trimming the coagulated skin edges with scissors. Excessive muscle contraction interfering with fine dissection, hesitation to use the instrument in the vicinity of large vessels and nerves, especially in the axilla, the danger of a spark jump, and the danger of ignition and explosion of gaseous anæsthesia have been emphasized as disadvantages by some of the surgeons in some of their cases.

As in all new methods enthusiasts for this method of surgery possibly exaggerate its advantages while others start with natural prejudices against it, some not having mastered their instrument. It is probable that the truth lies between these extremes and the element of time will serve to delimit the sphere of special usefulness of this method of surgery.

This research will be continued until a sufficient number of surgeons familiar with the method have performed a sufficient number of operations in different diseases of different organs to justify absolute conclusions.

The 913 cases on which the present study is based have been tabulated, but it is not considered wise to publish the details of so small a group of cases for fear of their signifying an undue merit or demerit in individual groups of cases. It is also probable that manufacturers by analyses of the results obtained will find ways to improve the instrument. Due acknowledgment is made to the surgeons and manufacturers who have made the research so far possible.

[1] Presented in the Conference on Electrosurgery, before the Clinical Congress of the American College of Surgeons, Philadelphia, October 13–17, 1930.

CANCER CONFERENCE AND SYMPOSIUM

THE AMERICAN COLLEGE OF SURGEONS AND THE CANCER PROBLEM[1]

BURTON J. LEE, M.D., F.A.C.S., NEW YORK
Clinical Director, Memorial Hospital

THE American College of Surgeons during the past 8 years has been carrying on a campaign in connection with the control of cancerous disease, its treatment, and new methods of diagnosis which may be developed. A great deal of this work has been done in the Department of Clinical Research—in fact, all of it—and under the chairmanship of Dr. Greenough, of the Committee on the Treatment of Malignant Diseases of the College, a survey has been conducted during the past 10 years. This committee has reported upon the results of irradiation treatment in carcinoma of the cervix, also carcinoma of the breast.

More recently the College has, through an action of the Board of Regents in October, 1929, entered upon a more thoroughly organized effort to furnish throughout the country a better cancer service for the patient suffering from cancer. In order to accomplish this object, an organization of cancer hospitals and cancer diagnostic clinics in various parts of the country is being carried out.

The stand in connection with these clinics has been outlined as follows by the College, and I will read it verbatim:

"The American College of Surgeons takes the stand that cancer is, in principle, a surgical problem; that the diagnosis and treatment of cancer should be recognized as a responsibility of the surgeon or radiologist who has had surgical training, that he should be qualified for this work by experience in the surgical pathology of tumors and in the employment of radiation methods as well as surgery for both the radical and palliative treatment of cancer, and that he should work in close co-operation and consultation with the radiologist in the use of X-ray treatment." For further details see SURGERY, GYNECOLOGY AND OBSTETRICS, 1930, li, 570.

We will first discuss the Cancer Institutes. We feel that it is most fitting in a conference of this sort that our discussion should be opened by Dr. Ewing, who has been identified with the work in behalf of cancer patients and the whole problem from every angle for these many years.

CANCER INSTITUTES[1]

JAMES EWING, M.D., NEW YORK
Professor of Pathology, Cornell University School of Medicine

IN the brief space at my disposal, I can present only a very sketchy outline of the general development and position of the cancer hospital and cancer institute.

I would like to call attention to the fact that in the last 50 years, especially in the last 25, and particularly in the last decade, there has been a continuous movement toward greater and greater specialization in the cancer field. It was about 1890 to 1900, or in fact, preceding that time, that the first cancer hospitals were developed. They were the Buffalo Institute, Barnard Skin and Cancer Hospital, the Memorial Hospital in New York—the London Cancer Hospital antedated these to some extent—and the Czerny Hospital in Heidelberg. Since that time an increasing number of hospitals have been organized in many countries with the idea of greater specialization and intensive study of the whole subject, and it was felt that the basis of the foundation of these hospitals was the necessity of having more highly specialized talent devoted to this subject.

[1] Presented in the Conference on Cancer Hospitals and Clinics, before the Clinical Congress of the American College of Surgeons, Philadelphia, October 13–17, 1930.

In the last few years, this movement has gained great momentum, especially in Europe, where, as you know, there are already in existence two large new hospitals in Italy, one at Milan and another at Rome—250 or 300 beds in each of them—splendidly organized and backed by the government and by the leading members of the profession of that country.

In Portugal there is a large new hospital being constructed at Lisbon. In Havana they have an excellent hospital, now in running order for about a year and a half, manned by specialists and covering the field in Cuba. In Argentine there is another. So you can see from the events that are not debatable, that there has been in recent years a very definite recognition that the control of cancer requires in this day the special cancer hospital and cancer institute.

The question I regard as no longer debatable is that the proper, normal development of cancer control cannot proceed properly without these special institutions. What is the reason? It is not hard to find, by anyone who is familiar with the details of the subject and its ramifications at the present time. In the first place, the most important factor has been the greatly increased knowledge of cancer and the recognition of the fact that it is not a single disease but a group of diseases, very variable in its different locations and characterized by variations in type and character and detail so much that in order to have an intelligent knowledge or to conduct intelligent control of a given case, one must have a wide experience in the field of cancer, probably more than in any other department of medicine.

Undoubtedly the advent of radiation therapy called for special equipment, special workers, and a whole new science—radiobiology, radiophysiology, and radiotherapy—which are now a very numerous group in our profession all over the world. The necessity of having modern talent in this field demanded that special facilities and special equipment be provided for this service.

Moreover, the advent of radiation therapy and the increased knowledge of the great variations in the different types of cancer rather cut the ground from beneath our surgical friends and made the problem of cancer not essentially a surgical problem, although a very serious problem for the surgeon, because the whole subject of diagnosis and treatment of the disease instead of being standardized now became an open field for debate and experimentation.

It was quite clear that under ordinary circumstances the general surgeon, occupied with many different fields, was no longer competent or capable, no matter how great his opportunities might be, to cover the whole field properly. So, from these various standpoints, it became necessary to bring together a group of specialists in many fields. I might refer particularly to my own department, that of laboratory diagnosis, which has become so highly specialized and demands so much from the pathologist that we are now developing tumor pathologists. The necessity of the very extensive experience of quite a different type from that of the old pathologist has demanded that there be tumor pathologists highly specialized in this field. That type of man can grow up only if there is available a large quantity of material for study.

So one may say that today the whole subject is so large and complicated that the field is beyond the reach of the unattached institution or unattached physician or surgeon. It requires group work on a larger scale.

The diagnostic procedures in the clinic as well as in the laboratory have become highly complicated and very numerous. Many new methods of recognition of cancer in its early stages have been developed and require specialization. How would you like to have your œsophagus œsophagoscoped by someone who is just beginning to learn how and has had very little experience or practical knowledge of the method, or your ureter catheterized by someone who could hardly find the ureter? And your bronchus —how would you like to have that bronchoscoped by someone who had not had experience under a leader? And so it is with every one of the hollow cavities of the body—they have become a subject of investigation by these rather formidable instruments, at least from the point of view of the patient, and experience in the use of all of these methods requires guidance, experience, before it can be properly done. And if we are to demand that there be progress in the use of all these methods and other methods devised which will facilitate still further the diagnosis of these early forms of cancer, how is that to be accomplished without material and experience?

My own feeling is that the fundamental basis which has determined the past growth of the cancer hospital and cancer institute and will determine it in the future is the necessity of experience with large material.

All this is not new. As you look back into the history of the active surgeons now, the active cancer men in the world today, you will find that they have all been specialists. There is Miles of London, and Gordon Watson, Jones, and Handley in this country, not to mention our other num-

erous contemporaries. Two leading American surgeons, I need hardly remind you, have devoted the larger part of their splendid energies to the treatment, diagnosis, and general study of a minor group of neoplasms, tumors of the central nervous system. The idea of specialization, the necessity of it, is not new at all. It was in the minds of many men years ago and it is only now that the broad scope of specialization needed in so many different fields has required the development of cancer hospitals and institutes.

Finally, there is one very compelling factor, and that is expense. In order properly to equip a cancer hospital or cancer institute, one must have money. I think that it would be quite questionable wisdom to attempt to establish a cancer institute without an endowment of about $10,000,000. Altogether it would require about that amount in order to cover the field properly. Of course, one can start on less. There is none that enjoys that material support at present. We are all looking for about that amount, and when one considers the proper organization of a cancer institute, I think he will find that he cannot cover the ground with much less than $10,000,000.

My topic is larger than the one assigned to me originally. I was supposed to talk of the cancer institute, the ideal, broadly-organized cancer unit, but it includes also cancer hospitals. I thoroughly approve of the development of special cancer hospitals in certain localities, large or small, provided they have the proper conception of their responsibilities and limitations and the proper endowment to carry on their work well. But I do think that the small cancer hospital in a small community labors under handicaps which it is difficult to overcome and that the best facilities are to be obtained eventually only in large communities.

The cancer institute functions, first, in service. It should deliver to a large number of people the very best service in diagnosis and treatment. In order to do that, one must provide a service of sufficient size to make the experience of the man at the head of any department fully adequate. He should have a large service of the uterus, breast, stomach, rectum, and bone sarcoma, so that he may know the variations; without a service of considerable size, I doubt that the best work could be done. I am not strong on this idea of the intensive study of a few cases. It is all right for certain purposes, but when you get cancer or I get it, we are going to have some peculiar variations in it and our chances will be better in the hands of a man who has had sufficient experience to know that this is what has happened, and this is the type of exception to the rule which he is now encountering.

Then, the cancer institute should be an educational center on a large scale. It should engage in public education and public propaganda. It should have an auditorium and a place for conveying information to the public. It should, of course, be the very center of the education of the physician, particularly the undergraduate—who gets very little in the cancer field today—and above all, the postgraduate.

Courses in every one of these fields should be opened freely to men who are willing to devote themselves to this field as specialists.

The research fields are most important and most expensive. The research department of a cancer institute of this sort, to be ideal, should cover practically all the recognized fields of research, not only the simple descriptive knowledge of the various forms of cancer, which is extremely important and immediately productive of human value, but in every branch of science which may lend itself to the solution of that ultimate problem of cancer which so many people are interested in, that is, the ultimate cause of cancer.

There should be specialists in medicine and in pathology, physicians, laboratories on a large scale and well-equipped—a university department of physicians; there should be biophysics, biochemistry, and biology, experimental and practical; there should be a genetic laboratory. I believe all these departments of pure science looking for the ultimate cause of cancer will prosper more and get more scientific stimulus from contact with a group of active clinicians and the flood of problems which are constantly arising in the large cancer hospital and will do much better work than they will alone.

This, then, is something of the idea of the cancer institute. I believe there should be 5 or 6 of these in this country, of the ten million dollar standard. They should be located in Boston; in New York; in Baltimore; possibly in Washington—if we might hope for such a thing—under the Government; in New Orleans; in San Francisco; in Minneapolis; and in Chicago. They should be strategically placed to be centers of influence aiding the smaller institutions, the cancer hospitals, and general hospitals in the control of this whole work; and I see no plausible reason why that should not be accomplished in this great country.

DESCRIPTION OF THE CANCER HOSPITAL OF THE STATE INSTITUTE FOR THE STUDY OF MALIGNANT DISEASE[1]

BURTON T. SIMPSON, M.D., BUFFALO, NEW YORK
Director, State Institute for the Study of Malignant Disease

THE State Institute for the Study of Malignant Disease at Buffalo was created for the study of cancer and allied diseases. It consists of five departments of which the hospital is one, viz., (1) pathological, (2) bio-chemical, (3) biological, (4) physical, (5) therapeutic. Each department is headed by a man especially trained in his particular branch of the work.

The Institute is entirely supported by state appropriations which average approximately $200,000 annually.

As this conference is chiefly concerned with cancer hospitals I shall confine my remarks to our therapeutic department. This department is housed in two buildings connected by corridors on each floor. One building is the hospital proper containing 30 beds of which 16 are in two wards and 14 are in private rooms. The hospital has a modern operating room with facilities for diathermy, cautery, and implantation of radon. The nursing staff is composed entirely of graduate nurses and consists of 8 women and 2 men.

The adjacent building contains on the first floor, the dispensary and examining rooms for the reception of patients. The second floor houses two high power deep X-ray therapy machines and also treatment rooms. The third floor has the diagnostic X-ray machines, film examining rooms, and special rooms for œsophagus, genito-urinary, and rectal examinations. The fourth floor is devoted to records, and there are complete filing facilities and a corps of 8 record clerks and stenographers.

The staff is headed by a full time surgeon who is a Fellow of the American College and who is thoroughly grounded in the treatment of malignant disease by radium and X-ray. There is also a full time roentgenologist who has charge of X-ray treatments. Seven other members of the hospital staff are on service from 9 a.m. until 1 p.m. each day during the week. Among these is a dermatologist, a surgeon, and a genito-urinary specialist. These men all receive compensation for their services in the nature of a salary. As it may be of interest, the salaries of these men are as follows: one at $8,000, one at $5,500, two at $3,500, and five at $2,000. We have also a consulting staff composed of a surgeon, a laryngologist, a gastrologist, and a urologist.

The consulting staff has no direct compensation but has the privilege of obtaining radon at cost. The pathologist, the physicist, the biological chemist, who head their respective departments of the Institute and are full time men, co-operate with the hospital staff. Daily conferences are held by the regular members of the staff and a luncheon conference is held weekly.

Three mornings each week are set aside for the reception and examination of patients. On these mornings from 50 to 100 persons appear at the clinic. Although some of these are new patients, the majority come for re-examination after treatment.

The new patient has a special history taken and a complete physical examination made, including blood, urine, and such special laboratory and X-ray tests as are indicated. The patients come from all parts of the state except Greater New York and the majority are referred by physicians. A duplicate record of our findings is sent to the physician referring the case.

Inasmuch as this is a research institution, we are at present concentrating most of our therapeutic activities on radiation treatment to ascertain the precise place which this agent occupies in the control of malignancy. Therefore, we do only such surgery as is necessary in connection with other treatment or for persons who cannot afford to have it done elsewhere.

Our radiation equipment comprises two high-powered X-ray machines capable of delivering 250,000 volts at 30 milliamperes. Both of these machines have water cooled tubes. At the present time we have at the Institute 2 grams of radium in solution and about 100 milligrams of radium salt.

The New York State legislature at its last session appropriated $300,000 for the purchase of more radium for the Institute and we have ordered 4 grams for a pack and nearly 2 grams in the form of radium salts, for needles and other applicators. We expect to receive this new supply of radium within a year.

We do not accept advanced and hopeless cases in our hospital as you can readily see that this would fill our beds and make them unavailable for patients to whom we could be of benefit. The beds are utilized mostly for patients during treat-

[1]Presented in the Conference on Cancer Hospitals and Clinics, before the Clinical Congress of the American College of Surgeons, Philadelphia October 13–17, 1930.

ment. The turnover for each bed is thus large during the course of a year.

A biopsy is made on nearly every patient. Naturally this is not done in cases where it would be hazardous. In our somewhat extended experience with biopsy we cannot recall any single case which we believe has suffered from this procedure. However, in all cases where biopsy is done, it is followed by immediate treatment, which probably accounts for our favorable outcome in this practice. Every patient who is taken into the hospital must agree to an autopsy.

Besides the research work done in connection with radiation therapy the hospital department undertakes the testing of various methods which are suggested from time to time and appear feasible. Thus the treatment of cancer by colloidal metals, as lead, gold, bismuth, etc., has been thoroughly tried out. Studies of the changes in the blood constituents due to radiation therapy are being carried on.

The relation between the histological picture and the reaction to various types of treatment is being studied, also the value of histological groupings. It is the practice of the members of the hospital staff to study the histological sections of the biopsy material from the patients who are treated in the hospital.

It is now the routine practice to make X-ray plates of every bone in the body in cases of carcinoma of the breast, thyroid and prostate gland, to determine the frequency and distribution of bone metastasis in cancer of these organs.

During the past year there were 1,450 new patients who applied for examination and of these, 1,189 were accepted for treatment. The other 261 cases were rejected either because they were not suffering from malignant disease or because their condition was hopeless. The number of cases seen was 2,885 which involved 11,940 calls. The patients treated are required to return to the clinic at certain intervals for re-examination and observation. Each patient is given a "return card" and a duplicate is filed with the follow-up department.

A summary of the actual work done at the hospital during the past year may be of interest. On December 31, 1929, there were 8,978 complete cancer case histories on record. During the year there were 2,885 patients examined. There were 51 major operations and 945 minor operations performed. Four hundred and sixty-one of these were done with gas anæsthetics and 524 with local anæsthetics. There were 206 cystoscopic, 15 œsophagoscopic, 59 proctoscopic and 120 fluoroscopic examinations made. There were 447 treatments by interstitial implantation of radon, 255 treatments by radium tubes, and 200 surface applications of radium. The revolving radium pack was used in 38 treatments and the 10 centimeter pack in 101 treatments. Three hundred and twenty-two treatments were given by unfiltered X-ray and 2,931 were given by high-powered X-ray.

As near as we can segregate the expense of the hospital from the entire expenses of the Institute, it would appear that the annual current expenditure is about $100,000.

The opportunities are extended to qualified physicians to come to the Institute to observe our work and study our methods. In the past a number of men have taken advantage of this invitation and have studied with us for varying periods.

DISCUSSION

RUPERT H. FIKE, M.D., Director, Steiner Cancer Clinic, Atlanta, Georgia: It is with a feeling of a great deal of trepidation that I attempt to discuss cancer clinics, after having heard the subject presented by Dr. Ewing and Dr. Simpson. There are two or three things that stand out in their statements. The one that hits nearest home in regard to the Steiner Clinic in Atlanta, is the fact that Dr. Ewing states that $10,000,000 is necessary for the proper conduct of a cancer institute. I doubt if there is $10,000,000 in Georgia right now, much less in Atlanta. It is a very difficult matter to get the amount of money necessary properly to operate a cancer hospital.

I take it that the big difference between a cancer institute and a cancer hospital is the question of research work, the question of experimentation as against treatment entirely. I have thought for some time that all of the larger institutes have a great deal more money, a great deal more men for work, a great deal more experimental laboratory workers than we in the South are able to get. Our time and our men's time is fully occupied with just plain cancer treatment. Unfortunately, the vast majority of the patients who come to the Steiner Clinic are perfectly hopeless when they come in. I think, if anything, that this fact shows the need of these specialized cancer hospitals more than anything else.

The economic question immediately arises. When these patients come to the cancer hospital they are usually far advanced and are perfectly hopeless as to cure, and in addition to that, they have used practically all of the money that is available, the money that they had or the money they have been able to borrow or get from their friends.

I feel, therefore, that if these special cancer hospitals do nothing other than to make a little more comfortable the terminal period of the hopeless cases and to extend that comfortable terminal period a little longer, they have amply served a definite purpose.

At the Steiner Clinic we have little or no research work. We have taken the attitude that other institutions with more facilities and better advantages for doing this work may be safely entrusted with that type of work. Thus we occupy almost a position of a parasite: we try to keep up with what others are doing and when they arrive at a definite conclusion about what is a good thing to do, then we accept that without a great deal of discussion; we just take it as a matter of fact and appropriate it to our own use.

One point that Dr. Ewing made I think ought to be stressed, regardless of a $10,000,000 endowment fund. I believe it was Oscar Wilde who says in "The Ballad of Reading Gaol,"

"Stone walls do not a prison make
Nor iron bars a cage"

and a marvelous pile of brick and mortar, even if it is trimmed with marble, does not make a cancer hospital.

Not the least valuable asset of any cancer hospital is the experience and training of the staff. The men who work in the cancer hospital make the hospital. In Atlanta, we started from scratch, so to speak. There had not previously been any organization of men devoting their time or their thought toward cancer, and I consider that the most valuable adjunct of the Steiner Cancer Clinic at the present time is a staff of 20 men with 5 or 6 years of intensive training in cancer work.

Previous speakers perhaps have not had experience along that line, but more or less frequently, I have seen patients who were operated on by unattached surgeons when the case was incurable, by reason of the description from the patient, by reason of unmistakable evidences that could be had on examination; and the result has been that such patients were made worse by ill-advised surgical effort.

All of you will remember the magnificent work that the American College of Surgeons has done in elevating the standards of surgeons all over the world in the matter of fee splitting. If they can control such an insidious evil as that, I have a feeling that the American College of Surgeons can do a great deal for the treatment of cancer.

ERNEST M. DALAND, M.D., F.A.C.S., Chief of Staff, Pondville State Cancer Hospital, Wrentham, Mass. In 1927, the Massachusetts Department of Public Health, under mandate of the legislature, opened the Pondville Hospital for cancer. The public, realizing the need of beds for advanced cancer cases, had sought relief through its representatives at the state house. The legislature went one step farther and directed that people with cancer or suspected cancer in any stage should be eligible for admission, provided they were residents of the state. This was the first time a state had spent money to found and conduct a hospital primarily for the treatment of cancer patients, and the state to do so is the one with the highest cancer death rate. Previously, state funds had been used to care for the insane, the tuberculous, the feeble-minded, and the alcoholics, all dangerous individuals to have in the community.

The Pondville Hospital is located in the country some 20 miles from Boston. At first there was some question whether its 90 beds could be filled. Within a year the hospital was running at capacity, with a waiting list shortly after. Last spring, 25 more beds were added, but there is still a waiting list. Formerly the buildings were used by the state for other purposes, but previous to opening as a cancer hospital, extensive alterations and additions were made. Recently, a well equipped clinic and an enlarged X-ray department have been added to fill definite needs. All of the new beds have been added in single rooms, until now more than half of the patients have single rooms.

Fully equipped operating rooms, deep X-ray machines of the latest type, a gram of radium, an electrosurgical unit, good laboratories, a library and everything needed to conduct an approved hospital are provided. Patients able to pay their own bills pay $10.50 a week. If unable to pay, their cities or towns are assessed at the rate of $17.50 a week. The actual gross per capita cost is $35. However, no patient is turned away for financial reasons.

The resident medical staff consists of a medical superintendent and 4 residents, all graduates of surgical or rotating services of general hospitals. The nursing, in charge of a superintendent of nurses, is carried on by 19 graduate nurses with 31 attendants. A training school for attendants is conducted, with a course of one year. Adequate nursing is provided so that special nurses are not needed, as a rule.

The visiting staff is made up of 17 men. These men are all working on cancer in other institutions in Boston or elsewhere, but none of them limits his work to cancer. Eight of these men devote 2 half days a week, 3 others, one half day, and the others are called as occasion demands. All of the surgical and medical specialties are represented.

A clinic is held on Thursday afternoons for new patients, ambulatory patients and for follow-up work. Consultations are held over patients by 7 or 8 members of the visiting staff. The radiologist is prepared to make any examinations which are indicated. The internist gives his opinion of the patient's condition, if operation is being considered. The technicians make the laboratory examinations. The dentist sees mouth cases and cleans up the teeth and gums before operation or radiation is considered. Conferences are then held on the patients in the hospital and decisions made as to diagnosis and treatment. No matter how advanced the case, or how obvious his condition, thorough examinations are carried out by X-rays, the œsophagoscope, the proctoscope and so on. Occasionally, the advanced "cancer" of the stomach proves to be an ulcer with obstruction.

All patients are seen by a member of the visiting staff twice a week. The more important surgical and medical work is carried out by a member of this staff. In one average month of this year, 13 visiting men spent 248 hours at the hospital, an average of over 3 hours for each of 79 visits, or at the rate of 62 visiting hours per week. The visiting staff receives salaries from the state.

Careful unit records are kept. An attempt is made to keep in touch with the patient's family physician by frequent reports in each case, including a record of the initial examination and recommendations for treatment and a final discharge letter. Two social workers devote their time to investigation of patients and patients' affairs and aid materially in the follow-up of the patients. Letters are sent reminding them that they are due at the next clinic. If they do not appear, home visits are made. Much aid is given in this work by the social workers in the state-aided cancer clinics located throughout the state.

Many patients are admitted with early, curable cancers. Some of these are treated by X-ray or radium or both. About 40 operations are performed each month, but some of these are of a palliative nature. Fully one-fourth of the patients admitted would be classified as moderately advanced. Many of them may be saved by extensive operations, combined with radiation. Others are kept alive in comparative comfort for months or years by palliative operations such as colostomies, gastrostomies, cordotomies, alcohol injections, and nerve sections. Others get great relief by radiation alone. Many of this group of patients return to their homes and come back at intervals for treatment and eventually for final care.

It is in the latter group as well as in our advanced group, which makes up a full third of our hospital population, that proper nursing plays so important a part. Our superintendent of nurses reported to me last week that with 115 patients in the hospital, some for more than a year, there was one bedsore. This was present on admission and is now nearly healed. I consider that a lack of bedsores indicates good nursing.

We have laid great emphasis on the proper dressing of foul, ulcerated lesions. Such lesions are cleaned up carefully, all slough is removed, and the dressings are changed many times a day. In this way, pain is alleviated and odors

are done away with to a large extent. We have never had occasion to use any deodorants or disinfectants since the hospital was opened. Urological and rectal cases present the only real problems as far as odors go.

We have been surprised to see how quickly opiates can be eliminated in many instances by cleaning up the infection in an open wound. Aspirin and codeine are our two most useful drugs, although there are some instances where morphine has to be used frequently. It is rare that any patient has more than ½ grain a day.

One advantage of a hospital of this type is that the administration can admit any cancer patient at any stage of the disease. A large general hospital hesitates to admit a moderately advanced case for fear he will occupy a bed for too long a period and thus keep an acute case from being treated. So the early, curable cancer goes to the acute surgical hospital and the late case to a chronic institution, but the patient who is in between has few places to go. A man may need to be hospitalized during a period of radiation as much as for an operation, but he is not welcomed by the average general hospital. Then, it is a distinct factor in raising the morale of the patients, nurses, and both the resident and visiting staff to have patients leaving the hospital apparently cured. No group of doctors or nurses can remain at its best if it feels that every patient who enters the front door will leave by the back door.

Of course, we have a great many deaths in our hospital. We frown on the doctor who keeps his cancer patient until one or two days before death and then wants to get him off his hands. The only advantage I have seen in having our small waiting list is to prevent such patients from being moved across the state to die in our hospital. We secure autopsies in about 45 per cent of the deaths. Our state requires permission for an autopsy from a member of the patient's family. In many instances there is no family, or they live too far away for us to reach them.

Patients apparently cured of their cancer or suffering from a disease not cancer are not allowed to remain in the hospital. They are sent back to their families or sent to other institutions.

Since the hospital was opened 3 years ago, over 2,600 patients have been cared for in the clinic and the hospital. This year we shall have about 600 new patients in the hospital with 250 old patients. In addition, we shall have 600 new clinic patients as well as 1,500 old patients.

In closing, I wish to say that there is the fullest cooperation in the Pondville Hospital between the Department of Public Health and the staff and between the superintendent and the staff.

WILLIAM T. PEYTON, M.D., Cancer Institute, University of Minnesota, Minneapolis: Our Cancer Institute was organized in 1925 and started in the latter part of 1925. I will not go into great detail about the organization but I will give the important points in the Institute's organization.

The Institute is under the direct supervision of the head of the department of surgery, but is a sub-department just as we have the department of orthopedics and the department of urology. Therefore, the Cancer Institute has its sub-head. There are a full time physicist, technicians and a full time assistant for the physicist. We have also a full time stenographer in the Cancer Institute.

The patients all come through the general dispensary, the general diagnostic clinic, and then they are sent to our tumor clinic as a consultation service. The tumor dispensary was opened in May, 1927; therefore, there were 8 months in 1927 during which the tumor dispensary was in operation. In those 8 months, we had 160 new patients. In 1928, or the second year in which the clinic was in operation, this was increased to 212 patients. It really was not an increase, because the first year, 1927, was only for a period of 8 months, so there was practically no increase during the second year. But, in the third year, 1929, with a little better service to the patients in the dispensary, the number of new patients was increased to 385, practically twofold increase over 1928. This increase was apparently brought about entirely through just a little better service to the patient in the dispensary and a little better cooperation with the referring doctors, by writing letters back to the referring doctors so that they apparently felt more kindly toward us.

We feel that a very important part of the tumor clinic is its teaching value for the medical students and we try to use all of the tumor material to its full extent in connection with teaching both diagnosis and treatment of malignancies to students. Therefore, we have organized a required clinic for the students in the senior year which is conducted by one of the pathologists of the university department of pathology and one of the senior members of the surgical staff. These two men conduct the clinic once a week for a period of one hour for the senior class.

In addition, we have students who attend our tumor dispensary. We can have only two students at each clinic because of the limited space in which the clinic is conducted. We also conduct a publicity campaign. We have a weekly radio talk on health topics under the auspices of the Minnesota State Medical Society. One of these talks each month is devoted to the subject of malignancy. We feel it is better to insert a talk on cancer in a series of talks on general subjects of health, rather than announce a series of radio talks on cancer alone, because, if we insert them in this way, the radio audience does not know when a talk on cancer is to be given and, therefore, will listen in, whereas these same people probably would not tune in just to get a cancer talk.

In addition, we have a monthly article in *Everybody's Health*, a health magazine for the laity. We also conduct a series of lectures for negroes in the cities of St. Paul and Minneapolis. There are 28 of these lectures to be given between now and the first of the year, 6 of which will be on the subject of malignancy. These are given in negro churches, clubs, open forums, and so on.

The subject of autopsy, in Minnesota, I think is interesting; we have had a school for embalmers at the University of Minnesota since 1906, and in that way, have trained practically all the embalmers in the state. We have, therefore, taught them the need or the advantages of autopsies; we have taught them how to embalm an autopsied body and they all feel very kindly toward autopsies. As a result, there is no opposition on the part of the undertakers to our obtaining post mortem examinations. We have to get the consent of the nearest relative, but nevertheless, we get over 70 per cent autopsies on all deaths at the University Hospital.

JOSEPH E. GENDREAU, M.D., Ph.D., Director, Radium Institute of University of Montreal and Province of Quebec, Montreal: We have tried during the last 5 years to organize a radium institute especially for cancer work. It is a radium institute for research and therapeutic purposes. It is connected with the Montreal University. The Government furnishes the funds and the university at first furnished the equipment which is not elaborate. We have 7 high-tension X-ray machines, 200,000 volts for 6, and 300,000 volts for a new one recently installed and working for the last 5 months. We have tried to remain independent; that is to say, we have tried to keep the Radium Institute as a separate faculty in the university. To keep that independent, we have called upon the faculty of medicine and the faculty of science to break their common connection on the directory of the university.

The Montreal Hospital, as well as the Government and the city of Montreal, has the privilege of sending delegates.

We have worked a little in research, especially comparing the different methods (American and European especially) in X-ray treatment. We are now trying to follow the cases with electrocardiographic studies as a research because we think that high-tension X-ray work has a very evident result upon the heart, which can be followed clinically and also in the laboratory work.

We are contemplating using much more the funds of the University Hospital because we have not a great part of that $10,000,000. We are obliged to call upon the University Hospital which will furnish the greatest part of the staff because we think that we must work in group action which is now absolutely necessary.

We have 5 full-time and many consulting physicians and surgeons; we have 6 clinicians, and 16 graduate nurses working every day, and will treat 50 or 60 cancer patients a day.

THE TUMOR CLINIC OF THE MASSACHUSETTS GENERAL HOSPITAL[1]

ROBERT B. GREENOUGH, M.D., F.A.C.S., BOSTON
Chairman, Committee on the Treatment of Malignant Diseases

WITH the recent development of laboratories and institutes for the study of cancer in this country and abroad, and the opportunities thus provided for the intensive study of the surgical pathology of cancer and of its treatment by surgery and by radiation, it soon became apparent that no one man could attempt to cover the whole field, but that a whole group of men, well trained each in his own line, and working in close co-operation one with another, was needed to assure to the unfortunate cancer patient the best available diagnosis and treatment of his disease. Such a group must include primarily the surgeon, the surgical pathologist, and the radiotherapeutist, but the further co-operation of the internist, the dermatologist, the genito-urinary surgeon, and other specialists is much to be desired.

It is not alone in cancer that this tendency for the group study of diseases has made itself manifest. Our knowledge of the diseases of the thyroid gland, of diabetes, of special blood diseases, and of a number of other conditions has advanced materially by the application of the group method.

In 1919 these facts were recognized by Dr. G. W. Holmes, chief of the X-ray department of the Massachusetts General Hospital, and he invited certain interested individuals on the staff to sit in consultation with him from time to time to consider the different classes of cases referred for radiation therapy, and to observe the results of treatment by radiation. This service began with diseases of the skin and of the thyroid, but was soon extended to include cancer. From this small beginning there grew a most interesting and instructive consultation service, and a degree of co-operation and mutual understanding was developed between the radiotherapeutic department and the general staff of the hospital which had not been present before this time, and which is still lacking in many other institutions.

As the advantages of this consultation service were more generally appreciated it was felt to be unwise to restrict it solely to those cancer cases which had been referred to the hospital for X-ray and radium treatment, but that all cancer cases coming to the hospital for treatment of any kind should have the benefit of this sort of group study and discussion before the decision was made in regard to treatment.

In April, 1925, therefore, this service was expanded to a daily, full time clinic, under the name of the "tumor clinic." A staff of about 20 physicians and surgeons was selected, including especially those men who had been interested in cancer problems in the different departments of the hospital. A chief of service was selected as an administrative head, and the joint responsibility for the service, as between the surgical and the radiotherapy departments, was definitely recognized. The staff includes a number of representatives of the surgical and of the radiotherapy departments, together with those of internal medicine, pathology, surgery of the nose and throat, of the genito-urinary tract, neurological surgery, and dermatology. Consultants in ophthalmology, orthopedics, and other special departments are occasionally called upon, and the general surgical staff deals with gynecological and rectal cases as special subdepartments in the general service. It should be said that the Massachusetts General Hospital is equipped with modern high voltage X-ray apparatus, all of the necessary surgical appliances, such as electro-surgical instruments, and a sufficient amount of radium to give adequate treatment to cases of cancer of the uterus by the emanation and insertion methods.

[1] Presented in the Conference on Cancer Hospitals and Clinics, before the Clinical Congress of the American College of Surgeons, Philadelphia, October 13–17, 1930.

The tumor clinic occupies a position intermediate between the house service and the out-patient department, and deals with cases from each service. A daily service, from 9 to 12 o'clock, is maintained, but the attempt is made to collect groups of cases on certain days in the week, as: Monday, leukæmia, lymphoma; Tuesday, general surgery; Wednesday, genito-urinary surgery; Thursday, nose and throat; Friday, skin; Saturday, gynecological and general surgical cases.

In order to avoid opposition from other members of the staff, the service of the tumor clinic being an innovation at its inception in 1925, was made entirely voluntary so far as reference of new cases was concerned. No obligation existed upon any member of the staff to refer his cases to the tumor clinic if he did not so desire. It was our belief that we ought to be able to demonstrate the advantages of the group study plan so conclusively as to lead the staff to supply us voluntarily with the material, and this has proved to be the case. The clinic now has an attendance of from 200 to 250 cases a month.

The only obligatory feature of the service so far as the rest of the hospital staff is concerned is the reference to the tumor clinic of all cancer cases discharged from the hospital. This was done deliberately in order that all of the follow-up work on this important group of cases should be systematically carried out by the tumor clinic staff.

For the past 20 years the Massachusetts General Hospital has enjoyed the advantages of a system of special assignments by which, on application to the general executive committee of the staff, a group of cases may be assigned annually to one or more members of the staff, in order to concentrate all of the hospital material and permit intensive study and productive work. Under this arrangement groups of cancer cases have been assigned either to individuals or, recently, to the members of the tumor clinic staff. With this assignment plan, cases of cancer of the breast, uterus, and mouth, bone sarcoma, and tumors of the brain and cord, are all concentrated in the hands of the members of the tumor clinic staff.

To summarize the advantages which may result from the organization of a special cancer clinic in a general hospital, it may be said:

1. The work in cancer cases is placed in the hands of those members of the staff who are most interested in that subject.

2. Opportunity is given by consultation with representatives of the clinical, pathological, and radiotherapeutic departments for mutual instruction and increase of knowledge of the disease and of its treatment.

3. A definite rational plan of treatment can be determined for each individual case, after consultation; and the results can be checked and discussed, by the group, in the subsequent follow-up.

4. Concentration of the hospital material permits greater experience and more productive work.

5. The standards of the hospital for efficient diagnosis and treatment of cancer are inevitably raised, and this educational effect extends beyond the hospital to medical students and to physicians in general practice in the immediate vicinity.

6. The additional expense to the hospital involved in the maintenance of the tumor clinic amounts only to about $3,000 a year.

THE ORGANIZATION OF A TUMOR CLINIC IN A GENERAL HOSPITAL[1]

JOHN J. MORTON, M.D., F.A.C.S., ROCHESTER, NEW YORK
Professor of Surgery, University of Rochester School of Medicine and Dentistry

THE proper management of patients suffering from neoplastic growths has become a problem of increasing complexity. It is no longer sufficient to refer all such individuals for one type of therapy. In order to give the best advice in each individual case it is frequently necessary to consult other physicians who possess specialized knowledge and training. It is a decided advantage, therefore, if all such patients can be referred for decision to a group of physicians acting as the nucleus for a tumor clinic.

In the University of Rochester Medical School, an effort has been made to refer all ambulatory patients with tumors to such a clinic. All cancer patients discharged from the hospital following operative or other forms of therapy are also sent to this clinic for further treatment and for follow-up care. Cases requiring a specialized form of therapy such as electrocoagulation or radium application through the cystoscope as in bladder tumors are best handled in the special clinic equipped for this service. Consequently the urological and the gynecological clinics take care of their own cases with neoplastic disease and obtain assistance from the radiological department when necessary. All the other specialists refer their cases directly to the tumor clinic for treatment. On the other hand, owing to the fact that the medical school and university hospitals are housed under one roof, it is possible for the tumor clinic readily to get the opinion of any specialist in pathology, bacteriology, biochemistry, medicine and surgery, etc.

The personnel of the tumor clinic consists of surgeons, radiologists, surgical pathologists, medical students, nurses, social service workers and secretarial assistants. The fourth-year medical students are assigned in rotation to this clinic. They record histories and physical and laboratory examinations on every new case and make follow-up examination on all the old cases. They are required to estimate the clinical index of malignancy (Lee) and the histological index (Broders) from the pathological sections when available. The patients are then seen by the surgeons and radiologists in consultation; the treatment is outlined; further laboratory examinations are ordered if indicated; and there is free discussion of the individual problem in every instance. In this way the examination, diagnosis, prognosis, and treatment are presented. Students may then be referred to similar cases under treatment so that they may get a broader viewpoint as to the course of any given type of neoplasm.

With very few exceptions a biopsy is required before any form of radiation therapy is instituted in the group of malignant tumors. Although it is granted that this is not always essential yet it gives such information as to the radiosensibility, the grade of malignancy and the probable prognosis that it is considered too valuable to omit. We are convinced that a biopsy taken with due care does no harm. After several years it may be possible to make a correlation between the gross appearance, the evolution of the lesion and other similar cases with a known pathological picture so that this step may no longer be necessary.

The presence of clinicians in the clinic insures against the tendency to give radiation treatment without adequate examination and discussion. The presence of radiologists insures against the tendency toward surgical intervention on every possible occasion. One group acts as a balance wheel against the other.

It has been found advisable to see all these patients in rooms provided in the roentgenological clinic. In this way when radiation is decided upon the patient is saved dressing for transportation to another part of the hospital. The clinical facilities for laboratory examination are in adjoining rooms.

The follow-up of patients with malignant disease deserves the most careful consideration. All physicians treating such individuals should feel a keen sense of responsibility for their after-care. Only in this way can the early recurrences or regional metastases be noted in time to receive prompt attention. The patients fall naturally into two classes, one undergoing active treatment, and the other receiving only follow-up examinations. Patients getting active treatment are seen at least once in 3 weeks. Follow-up examinations are made at least once in 3 months on patients who have passed through the active treatment stage. In order to safeguard against failure to keep appointments, the name is placed in a date file on the return date given the patient. When the date arrives, the name of the patient appears. Unless the appointment has been met,

[1] Presented in the Conference on Cancer Hospitals and Clinics, before the Clinical Congress of the American College of Surgeons, Philadelphia October, 13-17, 1930.

a letter is immediately sent to the patient asking why he did not keep his appointment with the clinic. In case no answer is had to the letter within a reasonable time, the social service worker is asked to find out if possible why the patient has not come in.

From the surgical side, the university hospitals are equipped with all the most modern electric scalpels and apparatus for electrocoagulation, electrodesiccation, etc. The roentgen-ray department has at its disposal the whole range of therapeutic radiations from infra-red to γ-rays of radium. There is a 300,000-volt, deep therapy X-ray machine which is adequately provided with ionization chambers to measure accurately the roentgen-ray dosage. There is only a moderate amount of radium available and this is a drawback from two standpoints: namely that the radium is not always available when it is needed; and, second, that the supply is not in plastic enough form, which fact restricts its usefulness.

This leads naturally to a discussion of the faults common to the establishment of an ideal tumor clinic in any general hospital. Scarcely any such institution has sufficient money to invest in the proper amount of radium so that it may be put into emanations. Very few general hospitals would be able to provide a personnel sufficiently trained to handle such an emanation plant if it were possible to get one. The lack of excess funds prevents the general hospital from buying radium emanations from outside. And yet there are a great many patients who would be benefited by such therapy which cannot be supplied by the general hospital. If the hospital happens to be a teaching hospital, this side of the instruction cannot be properly taught.

It seems peculiar that so few steps have been taken in the United States to meet this situation in a co-ordinated way. There is no more pressing problem concerning the public health than that of the cancer situation. And yet even when a well trained group of physicians is ready to use all the most modern treatment as advocated by the few big cancer institutes, there is no equipment with which to work. Is it not time that the state or national public health services make provision for the establishment of radium centers by the loan of adequate amounts of radium to general hospitals, with well trained and qualified staffs of physicians? In Great Britain 12 such centers have been established as national radium centers where the government provides for the treatment of its citizens. The results obtained have already more than compensated for the expense involved.

DISCUSSION

JONATHAN M. WAINWRIGHT, M.D., F.A.C.S., President, American Society for the Control of Cancer, Scranton, Pennsylvania: This meeting is an expression of the fact that cancer is no longer a one man job. It seems to me that as far as the hospital's contribution to the cancer problem goes, we have two very definite lines to think about: first, the special cancer hospital or the special cancer institute; and, second, tumor clinics in general hospitals.

I want first to emphasize what seems to me to be a very important fact, and that is this: that these two lines do not in any way conflict with each other; no matter how much a man may be in favor of one of these branches in particular, he should be just as much in favor of the other. In fact, each one can play very definitely into the hands of the other. If we needed any more enthusiasm for special clinics, Dr. Ewing has very definitely supplied it and I do not think it is necessary to try to amplify that in any way.

I think we need bigger and better special hospitals and lots more of them. However, it will be a very, very long time before the special hospitals will be able to provide for even a fair number of cancer cases. Take, for instance, the experience right on Manhattan Island under the shadow of the Memorial Hospital. The Memorial Hospital is certainly second to none in the world as far as service to cancer patients goes. However, as Dr. Ewing himself told me the other day, the Memorial Hospital treats only a very small portion of the cancer patients treated on Manhattan Island, and for every cancer case, for instance, that is treated in the Memorial Dispensary, I think there are scores that are being treated in physicians' private offices by physiotherapy or one means or another, which may or may not be of influence in the cure.

For every patient treated in the wards of the Memorial Hospital, there are many more that are treated in smaller metropolitan hospitals not especially interested in cancer and even in small nursing hospitals superintended by trained nurses scattered all over Manhattan Island.

So it is going to be a long time before the special cancer clinics can accomplish much statistically in the care of cancer patients. Awaiting that time, we must constantly improve the service of the general hospitals.

One thing I do hope will come out of this meeting, and that is this: that the College of Surgeons will increase their watchfulness of the treatment of cancer patients in general hospitals. I hope that the College will begin at once to have their investigators who travel from one hospital to another insist that the service to cancer patients be improved upon.

In the meantime I trust that we all will give our hearty support not only to the special hospitals but to the general hospitals. Then with such an arrangement I hope that by 1933 it will be the policy of the American College of Surgeons that no hospital be considered approved unless it gives adequate service to cancer patients through the media of tumor clinics and of other means mentioned.

HENRY SCHMITZ, M.A., M.D., LL.D., F.A.C.S., Chicago: It has been estimated that among the veterans of the World War, about 300,000 will die eventually from cancer, and that in addition about 100,000 under favorable circumstances will be cured, which means that in all probability about 400,000 veterans at one time or another will suffer from cancer. The United States Veterans' Bureau has estimated that probably 250,000 of these men will apply for treatment to one or another of the diagnostic clinics or hospitals. Thus the question is very important and a start has been made toward its solution as follows:

In the Central States—from Canada to the Gulf of Mexico, and from the Allegheny Mountains to the Sierras

—every veteran who is suspected of having cancer will be sent to the cancer center which has been established at the Edward Hines, Jr. (United States Veterans' Bureau) Hospital near Chicago. In this institution a wing has been remodeled and furnished with 150 beds, and a floor has been provided with a complete equipment for the treatment of cancer, that is, a surgical unit, an emanation plant, and a treatment room for the surface application of radium, especially the application of large amounts. The hospital has in possession 2,275 milligrams of radium. One gram has been placed in solution for emanation.

The organization has been divided into the ward service, the technical service, and the tumor clinic proper or treatment service. The ward service consists simply of ward surgeons who do the ordinary ward work and supervise the daily care of the patients. The technical service has two doctors who serve alternately. These men are not only doctors but are trained physicists and understand emanation therapy. With the help of the technicians, emanation can be obtained daily; and the amount of emanation contained in a seed measured, the radium which is to be used in deep seated cancer supervised, and at the same time minor radium applications made. These men will be on service for only 2 weeks and in the next 2 weeks, supervise and execute the X-ray treatments in the X-ray therapy department. Thus it is hoped that the accumulation of radiation may be dissipated. In other words, the two teams alternate their services every 2 weeks. Should one of the men be ill or absent, the staff can double up and the organization thus continues without interruption.

The tumor clinic itself consists of a general surgeon; a urologist; an orthopedic surgeon; a dermatologist; eye, ear, nose, and throat surgeon; a neurologic surgeon and a cardiologist. Additions to the staff can be made as necessity demands. The surgical department has especially trained tumor pathologists who are placed at the service of this clinic, and, of course, there is a pathological room directly in connection with the surgical rooms.

The object of the tumor clinic is to see and study every case that is admitted. It has seemed best that if a patient is suspected of having cancer, the diagnosis should not be made at the place where the patient lives, but rather that he be sent to the institution where the biopsy or diagnosis can be immediately followed by the properly indicated treatment.

In this tumor clinic also we hope to train each surgeon and to familiarize him with radiation therapy, for we believe that it is much easier to teach a surgeon the proper technique of the insertion of radium seeds than it would be to teach a man who owns radium surgical procedures.

With this unit we hope to train other units in the service because as years go by it will be necessary to establish other cancer centers in various parts of the country.

It may interest you to know that last June at the County Hospital in Chicago a similar tumor clinic was formed. During the summer various services were organized and it is intended to hold a weekly cancer clinic to which all the medical students and the medical participants who so desire may come, so that they may learn how a cancerous disease should be diagnosed and how it should be treated.

I feel that these two developments in Chicago and vicinity will probably do more for the stimulation of the erection of similar clinics and institutes in the Central States than any other undertaking has so far.

THE WESTCHESTER PLAN

A County Method for Cancer Control[1]

H. R. CHARLTON, M.D., Bronxville, New York
Chairman, Westchester County Committee

I SHOULD like to describe briefly the work which for the past year has been going on in Westchester County in the State of New York.

A little over a year ago Dr. Howard Taylor prevailed upon me to take up the question of control of cancer in my county. As this is the type of problem which interests us all it occurred to me that a vigorous county organization might become an example for the development of other county units through which by close co-operation an active intensive and effective state warfare could be waged against malignancy.

In Westchester County, which is bounded by New York City on the south, extends north to Putnam County, is bounded on the west by the Hudson River and on the east by Connecticut and Long Island Sound, we have a population of 500,000 people, 15 hospitals, and 560 doctors in active practice. This county in 1930 was per capita the wealthiest in the world. It was very obvious that with this background we would immediately be able to develop a very extensive campaign. A committee of twenty doctors was appointed to take up the work. During this first year we have developed the sort of service furnished by the New York City Committee, that is, the establishment of a central office with capable clerical assistants. Through this central office we have directed patients and assisted doctors in their cancer problems through correspondence and by telephone. We developed a drive for funds and secured $12,000 with which to institute the work. Lectures were given to groups of 50 or more people, 100,000 educational pamphlets and leaflets were distributed to doctors and to the public. There have been printed 936 newspaper articles and we have received 1,986 clippings.

[1]Presented in the Conference on Cancer Hospitals and Clinics, before the Clinical Congress of the American College of Surgeons, Philadelphia, October 13-17, 1930.

A great deal of out-door advertising has been done by means of posters and car cards.

Our staff presented one symposium before the County Medical Society. Similar practices have been previously carried on by the American Society for the Control of Cancer but limited entirely to large cities.

From here we started on an entirely new venture. Believing that in order to intensify the interest and bring our subject more forcibly before every man in general practice, it would be necessary in some way to bring to his attention regularly and systematically the possibility of malignant disease diagnosis and control. This has been accomplished.

The incidence of cancer in Westchester County is such that a physician sees perhaps four patients with cancer per year, which number is not enough to keep each man on his toes for the early recognition of the disease. One method of keeping the matter before the doctors of Westchester County has been to secure letters concerning cancer from prominent investigators of the world. These have been distributed at regular intervals so that every doctor in the county has received this personal contact. These letters are also sent to hospital internes and interested individuals beyond the county limits.

We also planned a circulating library on malignant disease for the doctors of Westchester. It was soon obvious, however, that a library might not be sufficiently used. Westchester is a large county and it is difficult to get books back and forth. We are therefore placing regularly each month, on the staff tables of hospitals throughout the county periodic literature for the use of the attending staffs. As time goes on we expect to purchase book by book the important works covering various phases of malignancy and to see that these are available to each hospital, being sent from one to another at intervals.

In addition to distribution to laymen and to doctors of literature on cancer we are extending use of free radium emanation for carefully selected cases and in the past few months have taken care of six patients. An interesting feature of this service is that where we have given radium —and it has been delegated in each instance to physicians who are trained in its use—members of the patient's family are paying, on their own volition, to the central organization, small sums of money at intervals.

Progress has been so rapid in this first year, the doctors are so enthusiastic about the work, and the public nursing organizations are so much interested in it that last week I discussed before a group of prominent women of the county the possibility of starting within a reasonable time, the first small unit of an ultimate cancer hospital for Westchester. Realizing how great is the demand for cancer beds in our cities and the total inadequacy of present establishments, looking forward to a tremendous increase in population, we have asked for a tract of 30 acres of ground to be situated about half a mile from a railroad station near one of our prominent parkways. A few years from now we hope to be able to have an institution where we can properly care for, at first, hopelessly ill, who now must suffer and die in the most wretched surroundings and without proper care, and where in time a special cancer hospital may be developed. As we are planning for an abundance of ground and are looking a long way ahead, say 50 years, it is conceivable that here in Westchester, close to New York City, may develop one of the cancer institutes which have been discussed by Dr. Ewing.

The idea that I wish to bring before you is this: If the Westchester plan is a success and from this beginning similar institutions are founded in various other counties of the state, New York will then have enormously powerful agents with which to combat cancer and undoubtedly the first result will be that cancer patients will be brought to hospitals in an early stage of the disease instead of when it has progressed to the hopeless phase.

If Ward and Farrar can show from their well known work at the Woman's Hospital that 30 or better per cent 5 year cures are obtained, if Healey can take the earliest types of carcinoma of the cervix and show better than 60 per cent arrest, if Bloodgood's assertion that 70 per cent of cancers of the breast are curable if discovered early enough, then it would seem that the present difficulty lies not with cancer institutes, special cancer hospitals, and the men working in these institutions but with an interval group working between these hospitals and the general public. In other words the difficulty lies in the fact that the doctor has not been properly informed of the importance of early diagnosis and immediate treatment nor the public to seek advice in time to get the best results from proper, adequate care.

During 1931 twelve regularly advertised clinics will be functioning under our direction and a public health nurse will be employed to keep and co-ordinate their records and follow up all cases.

DISCUSSION

ELIOT ALDEN, M.D., F.A.C.S., Member, Malignancy Board of the Hollywood Hospital, Hollywood, California: I was very much interested in Dr. Ewing's paper. He said

that it takes $10,000,000 to run a cancer hospital. I came here to find out what can be done with $1,000,000.

Our problem is a private general hospital with no cancer service. The cancer committee was formed about 3 years ago and consists of a gynecologist, a surgeon (both members of the College), a radiologist, a pathologist, an internist, a urologist, and a proctologist. We are working along by ourselves, but we need help. I feel sure from what I have learned today that there is a place for the smaller institution, but I think it requires co-operation and I am going back to try to do everything I can to co-operate with the College of Surgeons in this work.

The first essential it seems to me is a uniform method of keeping records and uniform control so I think we should all, no matter how small we are, join the circle and do all we can to improve our methods of handling cancer cases.

CHARLES K. P. HENRY, M.D., F.A.C.S., Member, Cancer Clinic at the Montreal General Hospital, Montreal: We do not have what we might call a tumor clinic or a cancer clinic, but we have a radium therapy department (of which I happen to be the chairman) that has undertaken to act as a nucleus for such a purpose. On that committee we have two surgeons, a urological surgeon, a dermatologist, the director of the X-ray department, an associate in gynecology, and other consultants as we require. The radium in our possession has come to us by a gift of a member of the committee of management. We have over half a gram at present and we have available funds for the purchase of another half gram. It is the intention of the committee at present to confine ourselves to therapy with radium salts in the form of needles, tubes, etc., but we are attempting to provide some means for radium seeds as needed. At present, through the courtesy of Dr. Gendreau of the Radium Institute, members of the staff have been able to obtain for public or private patients radium seeds when required.

It is felt by several members of the committee that the proper step for the hospital to carry out will be the establishment of a tumor clinic based on the plan so admirably carried out by the Massachusetts General Hospital. We have no possibility, at least as far as the English hospitals in Montreal go, of having a cancer hospital itself. There are two very large hospitals, each has its own equipment, and each is supplied with a certain amount of radium. Necessarily, both hospitals have quite adequate X-ray apparatus for therapy. We feel that for the present we will have to work along on the plan that we now have. We have our scheme of records based upon the Radium Commission of London, England, and our forms with the illustrations are divided into 6 sheets; one, we will say, for mouth and tongue, one for breast, one for rectum, one for the genito-urinary tract, and so on. There are 6 forms in use, so that we will have standardized reports and follow-up notes kept in the proper manner.

The staff of the radium room is composed of a custodian who handles all radium, prepares the needles, the dosage requisitioned; and a full-time stenographer. Our patients on coming back to the different clinics in the dispensary call on the man in charge. The girl comes down with the folder which contains every item of information regarding the patient to be treated and this record is kept complete from time to time as he comes back for treatment or observation. These records are kept in one place and do not in any way supersede the hospital records of that patient, neither in indoor (no matter what department), nor in outdoor dispensary, but the radium report, which is practically a cancer clinic report, does carry the number of the indoor record or of the outdoor record card of the patient.

JOSEPH MCFARLAND, M.D., Professor of Pathology, University of Pennsylvania, Philadelphia: Some years ago I suddenly became overwhelmed by an inferiority complex that made me feel extremely uncertain regarding deductions that I had been accustomed to make and that I now believe to be largely erroneous. For several years I have been a kind of consulting pathologist to pathologists and surgeons regarding tumor material, and after much thought on the subject it seemed to me that if we could establish central bureaus to which specimens could be sent from all of the hospitals in a city or in a vicinity, sufficient material and data might be gathered to enable more accurate diagnoses and prognoses to be made. I explained my ideas to some of my friends. They sympathized with me and in time secured a small sum of money with which to start such a center in Philadelphia.

We began our work on a small scale. We sent out letters to the laboratories in all the hospitals in Philadelphia, asking them to become members of this Central Bureau for the Study of Tumors. I called it by that name because I had not the slightest idea what its ultimate destiny or its subsequent problems might be. We received 45 answers and started with a membership of 45 hospitals. This number has now diminished to 40 through certain consolidations and the fact that some never sent us material and therefore were dropped.

Into this Central Bureau have come in less than a year specimens of more than 1,000 tumors of all kinds, principally carcinomata. One of the first things that we noticed in connection with our work was that some of the sections were very poorly prepared, showing that the technical work in some of the smaller hospitals was not all it should be. By judicious criticism on the part of the collector of the material, the quality of the laboratory work done in those institutions has been greatly improved. We have also succeeded in getting a number of the hospital technicians to come to the laboratories of the University of Pennsylvania where we have given them gratuitous instruction in how to prepare sections for study.

Another interesting thing brought out in this work has been the matter of record keeping. While many of the hospitals keep comprehensive records, some keep records which are of no value whatever. Therefore, when our representative began to make inquiries regarding the materials he collected at the different hospitals—information that should have been on the history record sheets—there resulted a desire to improve the system. We hope that eventually all of the hospitals in Philadelphia will realize the necessity of keeping complete records and of instituting follow-up systems.

We have so far succeeded in securing a collection of slides that can be used to assist in identifying in the future tumors of doubtful nature. We are now following up every one of the cases that is registered in the Bureau, and if we are successful in this follow-up and are able to keep track of the patient from the time of first examination until the patient dies, we should be able to determine exactly how long a patient may live with a given type of tumor, no matter what the type of treatment.

Through the hospital record numbers it will be possible for future students to learn how the cases have been treated, and by grouping the cases it may be possible to determine whether results in one hospital differ from those in another hospital and whether one system of treatment is superior to others.

I believe that the future holds much in store for us from the work of central bureaus such as the one located in Philadelphia. What the ultimate outcome will be I can scarcely foretell, but I do believe that it may lead to another very important matter and that is the governmental registration of all cases of malignant diseases. I believe that such registration should be confined not to the city

alone, not to the state alone, but that it should be practiced in the entire country and that there should be one Central Bureau directly under the supervision of our Federal Government. The United States Government seems to find no difficulty in a system of bookkeeping that concerns the pocketbooks of all of us, and I see no reason why it should not interest itself with a bookkeeping system concerned with the health of its citizens. We should be able to know the cancer families, the diabetes families, the high blood pressure families, and the feeble minded families. Would not such statistics help to solve the question of the etiology of tumors, of the tumor inheritance of families, and the advisability of members of such families intermarrying?

This is but a beginning but I believe that the possibilities of such bureaus in the future is limitless. I am glad to say that the Bureau here in Philadelphia has met with such enthusiastic approval that similar bureaus are being started in other parts of the country and in Australia.

STATE-AIDED CANCER CLINICS IN MASSACHUSETTS[1]

HERBERT L. LOMBARD, M.D., BOSTON
Massachusetts State Department of Health

FOR nearly 4 years state-aided cancer clinics have formed an important part of the program for the Massachusetts Department of Public Health. These clinics, located in 16 cities and towns, are easily accessible to all citizens of the commonwealth. They have been established in an attempt to improve the facilities available for diagnosis and treatment and to decrease the existing delay on the part of the public in seeking advice at an early stage of the disease.

Group specialization is needed in the diagnosis and treatment of cancer. As the average physician in Massachusetts sees between 4 and 5 cancer cases a year and these of different types, he cannot be expert in diagnosis of malignant disease. The Massachusetts program endeavors, by concentrating the cancer cases among groups of physicians, to form centers where adequate clinical diagnosis and therapy will be available. All other physicians should be taught that specialization in cancer is needed.

As we near the completion of the fourth year of our activities the time seems fitting to review our progress. Evaluation of a 4 year program on cancer is most difficult. Death rates will continue to mount for nearly 2 years after the cessation of the actual increase in the disease. Cures can be determined only after years. The reported interval of delay on the part of the patient before seeking medical advice may serve as some indication of the value of the service, but human testimony is subject to great error. Social follow-up furnishes an indication of the present condition of patients but it obviously has its limitations. The opinions of physicians and the public regarding the clinics are of some value, but at best our methods of evaluation are poor.

The department maintains a 115 bed cancer hospital with an out-patient service which acts as a model for the state-aided clinics. The group method of specialization is used here. Difficult cases found in the clinics can be referred to this institution.

The clinics are organized in the following manner: An opportunity is asked to present the program to the organized medical profession of a given city. If it seems suitable, the local medical society passes a vote of support to the program and authorizes the appointment of a local medical cancer committee. This committee is responsible for determining where the clinic or clinics shall be held, for outlining the policies, organizing the staff, supervising the quality of service, and directing the growth. The department meets with this committee to determine how it can best assist with its resources in personnel, supplies, and funds.

This policy has prevented the establishment of clinics in a very few communities, but in most parts of the State the medical profession has been co-operative. This method of approach seems sound, for while it might well have been possible for the State to conduct clinics without local medical sanction the antagonism aroused would have more than offset the results obtained.

The cancer committees have met many problems in the administration of the clinics. In some communities medical jealousy has required a divided clinic which meets in several hospitals. This naturally decentralizes the cancer load. Rotating services staff other clinics, while in still others, one doctor conducts the clinic. Such clinics are in opposition to the policy of group service. A few clinics arrange for a specialist from Boston to consult with them at regular intervals. This practice is both constructive and destructive. The presence of the specialist raises the interest and efficiency of the staff but tends

[1]Presented in the Conference on Cancer Hospitals and Clinics, before the Clinical Congress of the American College of Surgeons, Philadelphia, October, 13-17, 1930.

to detract from clinic attendance between his visits. The opinion of the medical profession on this and other points was obtained by personal interviews with 75 per cent of the doctors in one of the better clinic cities. One-sixth of this group thought that the clinics should be conducted wholly by outside specialists. They asserted that diagnosis by the regular staff was not of sufficient worth to warrant the existence of the clinics. Whether this attitude was due to professional jealousy or genuine conviction is problematical, but it raises an important question.

The Massachusetts state-aided cancer clinics admit patients for the first visit irrespective of their financial status. Subsequent care is based on the medical, social, and economic findings. This gives ground for criticism. In most of the clinics, diagnosis is free. About one-sixth of the doctors in the local survey deplored this so-called clinic abuse and others felt that charges should be pro-rated. In some cities the inability to organize clinics was due largely to the policy of allowing financially independent individuals to attend them. As State money is used in the clinics, it seems just that all citizens of the Commonwealth should be benefited alike, but this policy is so radically different from the general clinic management that it seems reactionary almost to the point of State medicine.

The great majority of patients attending the state-aided cancer clinics are on a higher economic level than those attending other out-patient clinics in the same hospital. They belong largely to the so-called middle class. The very poor and the very rich comprise a much smaller percentage of the attendance. In one clinic city nearly every person attending the regular out-patient department is known to one or more of the organized charities, while among the patients visiting the cancer clinics only a few are known to these agencies.

When the diagnosis is made, the financially independent person is referred to his family physician or if he has none is given a list of names of qualified physicians. In some cases a person unable to pay is treated at the clinic and in others is cared for by the organized charities.

Objections to this policy are many. Physicians frequently claim that the clinics are not sufficiently careful in estimating the financial rating of the individuals. The list of physicians furnished is also criticized. Some patients who return to their own doctors receive inadequate treatment. Most of the clinics cannot furnish adequate cancer therapy, due to lack of sufficient radium or high voltage X-ray machines. Theoretically, the patients needing such treatment are referred to the State cancer hospital, but in many instances they do not wish to travel to the institution. More adequate facilities are needed.

The physicians in the city surveyed freely expressed their opinions of the state-aided clinics. Two-thirds of them favored them, while the remainder considered them harmful or needing some change. About the same proportion felt that clinics benefited the cancer patients who attended, those who did not attend but sought advice elsewhere as a result of publicity, and the non-cancer patients who were reassured and given advice. The doctors who disagreed with the majority discussed poor diagnosis in the clinics, failure of reassurance for the non-cancer group, and the danger of publicity sending patients to the quacks.

The educational activities of the Department are directed toward both the physicians and the general public. Demonstration clinics under the supervision of nationally known authorities are held at frequent intervals. Some of these are in connection with the local clinics, others with the State cancer hospital, while on two occasions the hospitals in Boston co-operated with the Department in furnishing graduate instruction. At one of these in 1929, 211 doctors attended, a considerable number of these being men who were not members of the State Medical Society. Several of the clinics at stated periods have consultants from Boston. While these meetings are not usually in the nature of teaching clinics, physicians who bring their patients are given an opportunity to observe.

It is our opinion that the cancer clinics have stimulated physicians throughout Massachusetts to a greater interest in cancer. However, the doctors in our surveyed city felt that the presence of the cancer clinic was a negligible factor in the stimulation of their interest.

Lay education is being conducted both by the central office and educational committees in the clinic cities. These committees, which are appointed by the local medical cancer committee, are composed of such key people in the community as presidents of chambers of commerce, rotary clubs, women's organizations, and the like. These committees have charge of newspaper releases, radio broadcasts, special lectures, and studies of the resources of the community for the care and treatment of cancer.

Newspapers are instrumental in bringing a large number of the patients to the clinic. In 1929, 35 per cent of the clinic attendance was due to this form of publicity. A speakers' bureau

is maintained which supplies authentic talks on cancer to any organization requesting them. The radio, the motion picture, and numerous pamphlets are used. While we resort at infrequent intervals to intensive campaigns such as Cancer Weeks, it is the policy of the Department to keep cancer continually before the public. In some cities there is a feeling that our educational propaganda is too extensive. That the people are getting tired of hearing so much about cancer is a rather frequent criticism, but the vast number of questions that are always asked a speaker at public meetings rather belies this.

Three measures of the effectiveness of publicity are the interval of delay between the first symptom and consultation with a physician, the volume of patients consulting with physicians for cancer, and the amount of phobia aroused. The majority of doctors in the surveyed city felt that cancer patients were coming to them at earlier intervals since the establishment of the clinics. This is in contrast to our experience with clinic patients. Here the interval remains about the same, 6½ months before the first visit to doctor and about 1 year before the first visit to the clinic. About one-third of the doctors in the surveyed city said that they were getting more patients since the clinic opened. Nearly three-fourths of the doctors interviewed felt that cancer phobia has increased. Two-thirds of this group, however, felt that this phobia is beneficial while a few considered it a menace and beneficial only to quacks. Many doctors said that there was more interest than phobia being created.

Social service is carried on in every clinic. In the hospitals where this service already existed the social worker has taken over the activities of the cancer clinic, using what assistance is necessary. In many of the clinic centers no social service had ever been attempted and it was necessary for a social worker to be procured. The larger part of the State funds in these clinics is being used for this purpose.

The social worker makes the first contact with every patient and follows the cancer patient until death, and the non-cancer patient, who needs treatment, until under the care of a physician. If the cancer patient moves into another locality the social worker in charge of that section of the State is notified. Very few cases are lost, the majority of these being individuals who moved into other states.

Social follow-up is carried on irrespective of the financial status of the patient. In the doctors' survey about one-sixth of the physicians felt that more social service was needed. Apparently their desire was not to increase the type of service which is being rendered but to prevent patients who are able to pay from receiving free treatment at the clinics. While the social worker in the clinics gives much of her time to the economic problems of the destitute cases, she does not attempt in most cases to classify those in better circumstances other than by questioning them. Her work is primarily to arrange for the cancer patient. This seems more advantageous than having the social worker spend a large part of her time in determining the economic status of all patients, even though clinic abuses exist to a considerable extent, which is doubtful.

It is estimated that about 5 per cent of the cancer population of Massachusetts attends the clinics each year. The delay between the first symptom and the first visit to the clinics has remained practically the same. There has been a decrease of about 16 per cent in the attendance during the past year. In 6 of the clinics the decrease is significant from a statistical standpoint; in 2 there has been a rise; and in the other 4 there has been no change. The larger communities and the state cancer hospital show a fairly stationary attendance. Several of the smaller cities have a marked decline.

Over three-fourths of the cancer seen at the clinics are lesions of the mouth, uterus, breast, and skin. This, of course, is radically different from the location of cancers obtained in the death records.

One-fifth of all the patients have never consulted physicians for their condition prior to seeking advice at the clinics. A third of the attendance is due to newspaper publicity and another third to doctors.

It is impossible to measure the cures at this period but some estimate of the clinic program may be obtained by comparing the percentages of the 1927 and 1928 clinic patients alive at the end of 2 years. There were 50.5 per cent of the 1927 cases and 64.4 per cent of the 1928 cases alive 2 years after going to the clinic, and the difference between these rates is statistically significant. This difference applies not only to total cancer but also to cancer of the buccal cavity, female genitals, and skin. This may indicate an improved quality of service in the clinics and the subsequent follow-up, or more favorable cases coming to the clinic, or perhaps both.

The records show that about 1 per cent of the cancer patients who attended the clinics in 1927 have been lost to social service. About one-fifth of the skin cases have already died; two-thirds of the breast cases; slightly more than that of the

female genitals cases; and one-half of the mouth cases. These findings seem too high to warrant optimism and emphasize the dangers of delay.

In a study made of the reason for this delay we found that about one-half of the patients delayed in consulting a physician because they felt their condition was not serious, also one-half of the patients delayed treatment for 6 months after seeing a doctor. One-fourth of this last group did not receive adequate treatment because of poor advice furnished by physicians.

An estimate from a doctors' questionnaire in 1928 indicates that for every patient seeking advice at the cancer clinics, 22 go to the private physician. Whether or not they go earlier than to the clinic is problematical; whether or not they receive as good or better treatment is problematical; but the fact remains that we must educate the physicians to detect cancer earlier and we must insist that the public go to their doctors.

CONCLUSIONS

The clinic experience of the past 4 years in Massachusetts is pointing the way toward more adequate service for the future. It is extremely probable that some of the existing clinics will be abandoned. The policy of developing specialists in various communities does not seem to be working out, and the present tendency suggests a more concerted effort to increase the diagnostic ability of the whole profession through frequent consultative service, graduate courses in cancer, and demonstration clinics. Education and social service seem reasonably adequate and should be continued. Efforts should be made to improve the equipment in hospitals for good cancer service and patients must be referred to their physicians.

The burden for cancer control belongs to the rank and file of the medical profession and the function of the state should be to supplement rather than to supplant this.

DISCUSSION

JOHN W. COX, M.D., Field Representative, American Society for the Control of Cancer, New York: On behalf of the 73 hospitals and clinics which I have visited recently as the field representative of the American Society for the Control of Cancer I desire to express appreciation to the Committee on the Treatment of Malignant Diseases for the booklet recently published, *The Organization of Service for the Diagnosis and Treatment of Cancer*. The procedure here outlined has been based upon the accumulated experience of the Committee. That such a program is both feasible and practicable will become more evident after the various types of services described therein are brought to the attention of this conference by men who have had extensive experience in the cancer field.

This day, without a doubt, marks the beginning of your official recognition of the cancer control problem. The millions dead from this disease salute you. Anxiously and hopefully during the past few years their offspring have waited patiently for the medical profession to orient themselves relative to the present day knowledge concerning cancer. If individual effort on the part of a few could have applied this knowledge the problem would be well in hand today. However, few men have found their training, experience and knowledge to be self-sufficient. On the other hand, highly specialized men, with minds sharply focused on the effectiveness of the services rendered, have produced the most satisfying results. Nowhere has this fact become more firmly established than in the cancer control research work and in the services rendered in certain cancer hospitals.

There is little doubt in the minds of those who are in touch with the cancer control situation in the United States but that the few irregularities which are now evident in some of our cancer hospitals, in the cancer services of the general hospitals and in the cancer diagnostic clinics will be smoothed out under the guidance of the American College of Surgeons.

It is an established fact that the public and the medical profession are demanding better and more effective cancer service. The trend can be noted in the cancer activities in Massachusetts, Georgia, New York City, and Philadelphia. The demands of the medical profession are reflected in the statement that the American Society for the Control of Cancer is now carrying on studies of the facilities available for adequate cancer services in Maine, Rhode Island, and Kentucky. Invitations for similar studies have been given by the medical societies of Denver and St. Louis.

The increased emphasis on the subject of cancer at the annual meetings of the American Medical Association is especially significant in view of the fact that at the present time the American Medical Association is not officially particularly interested in the subject. For instance, 10 per cent of the scientific exhibit space at the last meeting at Detroit was devoted definitely to cancer. Of the 275 papers presented before the scientific meeting 23 were on the subject of cancer. The papers for one day at this present meeting of the American College of Surgeons are devoted to cancer.

Now that we definitely know that the public and the medical profession are becoming cancer minded the establishment of cancer hospitals should proceed along sane, economically safe, and conservative lines. Undue enthusiasm and "wild-cat" ventures will be held in check if institutions are established only in co-operation with and under the advice of the American College of Surgeons. Cancer hospitals of this nature require considerable financial support, either by endowment or by annual appropriation. With this fact in mind, general or private hospitals which have an ever-increasing deficit should hesitate to enter the cancer field.

CANCER HOSPITALS

When one speaks of a certain hospital as a cancer hospital a vision of a superior type of institution flashes across the consciousness of the average individual. This is as it should be. Hospitals which either officially or unofficially carry the term "cancer" as a part of their title should assume greater responsibility in the cancer field than general hospitals. In fact, they are expected both by the public and the medical profession to provide leadership, and through specialization and research to point the way, to the end that cancer services for the entire community may be made more effective.

The number of acceptable cancer institutes and cancer hospitals in the United States might be listed at a baker's dozen. There are a few others now in the process of reorganization and expansion which no doubt will soon be able to meet the minimum requirements.

In addition to these there are a comparatively large number of private and semi-private hospitals with an average capacity of 6 beds. These hospitals, although performing a limited amount of superior service as judged by the facilities available to their community, probably will not be able to survive competition. The services rendered usually cannot be compared favorably with those given by an adequate cancer service in a general hospital. In other words, they are one-man institutions—institutions in which surgery is combined with the use of one or more pieces of physical equipment.

As examples showing to what extent the name "cancer hospital" has been prostituted, one might read the following extracts from a survey of the cancer facilities available in one of our large cities:

"This is a private 3 bed hospital without any physical equipment for the treatment of cancer except a diagnostic X-ray machine which is used for superficial skin lesions. The name of this hospital is a misnomer and it has no obvious excuse for existence."

"This so-called cancer hospital is a private institution of 20 bed capacity. The owner, a physician, does not believe in surgery, X-ray, or radium. This hospital is representative of a large group of institutions in the United States which should not receive public support."

Hospitals of this type outnumber the efficient institutions two to one.

CANCER SERVICES IN GENERAL HOSPITALS

Before initiating a new project a wise engineer makes a survey of the general conditions and notes the details with accuracy. This has been done relative to the program on cancer services in general hospitals in the United States. The surgical facilities, the physical equipment and the possibility of securing specialized personnel have in turn been recorded. Particular attention has been paid to every hospital which is endeavoring to carry on any type of special cancer service. The hopes and ambitions of these institutions have been encouraged. The future of the present cancer-control program rests on this small nucleus of 44 out of the total of 1,579 approved general hospitals in the United States.

No attempt has been made to place a rating on the cancer services offered by these general hospitals. The fairness of this omission is evident. The standards for this service have only recently been adopted officially. These hospitals are to be congratulated on their initiative. The development of facilities for increased cancer services will undoubtedly continue. Your attention is called to the cheerful fact that 24 general hospitals are considering the possibility of establishing an adequate cancer service during the coming year.

The increasing interest in cancer control of the 516 approved general hospitals with deep X-ray therapy equipment is evident when one knows that the majority of these installations were made subsequent to 1927.

"It is probably true, as some have contended, that the radiologic departments in this country far outnumber the properly qualified radiologists. However, adequate facilities for postgraduate instruction are now provided in many of the larger teaching centers, and an ample supply of highly trained men will appear rapidly so soon as the governing boards of hospitals see fit to raise their standards and demand high grade talent in their radiologic departments."[1]

The situation regarding the use of radium in general hospitals is even less satisfactory than the use of X-ray equipment. Less than 400 general hospitals in the United States possess medical radium in varying quantities. The distribution of the medical radium is known with sufficient accuracy for all practical purposes. The total amount accounted for to date is 80 grams. This is distributed as follows:

	Grams
17 Hospitals, cancer institutes, and research laboratories each owning over 1000 mg	41.000
27 Hospitals with average of 344.4 mg	9.300
7 Private physicians with average of 847.2 mg	5.931
4 Private rental agencies with average of 1498.7 mg.	5.995
322 Hospitals and individuals with average of 55+ mg	17.774
	80.000

CANCER DIAGNOSTIC CLINICS

At the present time there are 40 cancer diagnostic clinics in the United States. The majority of these are located in Massachusetts and in metropolitan New York. Thirteen others are being proposed for two southern states.

Theoretically, the organizing of cancer diagnostic clinics appears to be a step in the right direction. However, sufficient experience with this type of work has not yet been accumulated to permit of its evaluation. The speaker confesses that during the past two years he has entertained three different opinions.

We must keep in mind that the resources available for the diagnosis and treatment of cancer differ widely in states predominantly rural from those available in the metropolitan areas of large cities.

The medical groups in the rural areas are unwilling to recognize as authorities in cancer diagnosis and treatment those physicians who have merely signified their desire to become specialists without the special experience necessary for such leadership. As a result, it is impossible to organize a diagnostic clinic with even a small degree of permanency. Even if it were possible to organize a cancer group with superior knowledge and training, without the active support of the medical profession and the necessary equipment it would be no more useful than a highly efficient city fire company in the Mohave Desert.

The personnel of cancer diagnostic clinics needs the moral, mental, and physical support which can be secured only by a close affiliation with a highly organized and efficiently equipped cancer therapeutic clinic. In a few instances, unaffiliated diagnostic clinics have had a modicum of success, but the eventual mortality is too high for this type to be considered as a potent factor in the solution of the rural cancer problem.

On the other hand, cancer diagnostic clinics affiliated with mother diagnostic and therapeutic clinics or hospitals might be conducted with a high degree of success to all parties concerned, not the least of whom is the family physician. We shall be glad to know from Dr. Lombard the reaction of the family physician toward the cancer diagnostic clinics as operated in Massachusetts under the Commonwealth Cancer Hospital. Here, again, the conditions are different from those obtaining in strictly rural communities. The cancer clinics of Westchester County, New York, which Dr. Charlton has discussed, should give us the data that we all seek relative to the effectiveness of the cancer diagnostic services rendered in a suburban community which is part of a large metropolitan area.

REASONS FOR THE DEFICIENCIES IN THE SERVICES

It is evident from various cancer studies in the United States, that the part played by the average physician and the average hospital will have little effect in reducing the rising incidence and death rate from cancer. Communities

[1] Charles L. Martin, E.E., M.D., Dallas, Texas, Symposium on Radiology, reprinted from J. Am. M. Ass., 1929, xcii, 1033-1040.

without the stimulating leadership of specialists doing cancer research lag far behind in their care of cancer patients. Rarely do hospital authorities on their own initiative seek to combine the present day knowledge of cancer with the skill of specialists. The feeble pleas for adequate facilities and equipment made by the few understanding physicians and surgeons and a minority of the members of hospital staffs are received with diplomatic gestures. The underlying causes for the refusal are usually due to the ever threatening deficit which prevents nearly every hospital from accomplishing its best, and to the apathy of the average medical man on the subject of the control of cancer.

The results produced in these communities are practically the same as those of 25 years ago. The average physician lives in the average community. He sends his patients to the average hospital which lacks the facilities and equipment considered necessary in 1930 for effective treatment of cancer. The results produced are discouraging. The experiences encountered offer little to the average doctor to build up a faith in the possible control of cancer.

Physicians in large cities having access to hospitals with adequate facilities and equipment frequently are as pessimistic as their brother physicians in poorly equipped hospitals. In most of these better equipped hospitals cancer patients lose contact with the hospital soon after treatment. Little or no effort is made by the hospital authorities to advise and guide the discharged patients. The quality and effectiveness of the service offered cannot be judged at a later date. The cures effected cannot be determined. Occasionally the obituary of a former patient is brought to the physician's attention. The stimulating effect of knowing his successes is denied him.

The cause of the pessimistic view entertained by the staff of well equipped hospitals is frequently found to be in the condition of the patients admitted. Patients who are admitted moribund and those who refuse treatment or fail to co-operate are few in comparison with the large numbers who procrastinate in securing a diagnosis and adequate treatment. Less than 2 per cent of the cancer patients in Delaware report early for treatment. The figures for certain cancer hospitals in Philadelphia and New York City are 4.2 per cent and 25 per cent respectively. In cities and communities in which only 2 or 4 cancer patients of a possible 100 seek effective treatment early, there is little opportunity for the services offered to be effective.

The most serious difficulty is that of getting cancer patients at the earliest stage of the disease into the hands of those competent to make a diagnosis and expert in the treatment of cancer. Such skill is difficult to acquire and is not widely possessed.

GENERAL PROGRAM

In order to cope with the deficiencies in the cancer services offered by general hospitals, the American College of Surgeons and the American Society for the Control of Cancer have pledged themselves to a definite program relative to their respective fields.

The outline of the program of the American College of Surgeons has already been presented to you at this conference.

The American Society for the Control of Cancer is especially interested in the early diagnosis and effective treatment of cancer. The Society urges the public to seek immediately competent medical advice concerning all suspicious lesions and symptoms. This advice, however, loses its force if an adequate service is not available where such cases can be accurately diagnosed and effectively treated.

For this reason it is the policy of the American Society for the Control of Cancer to conduct in the future its major educational activities in geographical areas served by adequate therapeutic facilities. This educational work will be conducted in a quiet, dignified manner in conformity with the best traditions of the medical profession. Such work is undertaken by the Society only following an invitation from the local medical society.

In order that the medical profession may decide upon the feasibility of a projected cancer service the American Society for the Control of Cancer, on invitation from the city, county, or state medical society, will conduct a study of the cancer facilities available in that community. It will later submit to such society, in the form of a confidential report, the data obtained, together with its recommendation.

The American College of Surgeons and the American Society for the Control of Cancer are not alone in their efforts to improve the cancer service in general hospitals.

"The radiologic committee of the American Medical Association, which is co-operating with the Council on Medical Education and Hospitals in this work will attempt to formulate the minimum requirements that the members of the committee feel should be put into effect in an effort to stimulate hospitals and other institutions to improve their departments of radiology or roentgenology and to create a demand for highly trained directors of such departments. However, hospitals cannot expect to obtain the services of talented and well trained men until the institutional positions are made sufficiently attractive, and it is my earnest hope that the radiologic departments of the future will be directed by competent physicians who are really practicing a specialty in medicine rather than by low salaried laboratory workers. Therein lies the hope of elevating radiology to its highest sphere of usefulness."[1]

In the last analysis, the responsibility in the field of cancer control in a community rests upon the local medical profession and upon the local groups which determine the policies of the general hospitals.

[1] Martin, Charles L. Loc. cit.

THE COLLEGE CANCER CAMPAIGN

BOWMAN C. CROWELL, M.D., CHICAGO
Director of Clinical Research, American College of Surgeons

I THINK you have ample evidence from what we have heard this morning that the College is in the ring against cancer as the College has been and still is in several other rings.

A number of my professional friends have come to me relatively recently with a considerable sense of discouragement over the possibility of getting anywhere in the campaign against cancer. The man who enters the prize ring with a profound sense of discouragement is liable to defeat. I have no such sense of discouragement but rather one of great hopefulness, and that hopefulness has been much inspired this morning by what has been said.

When I look through this audience and see men not only from Canada but from Portland and Seattle and San Francisco and San Diego—all the way down the Pacific Coast, from Arizona, from all the Gulf States, from all the Atlantic States, from the Central States—when I realize the earnest desire of these men to get some information concerning how they may help in this fight against cancer, how they may give the cancer patient who is coming to them the best available medical knowledge, how they may correctly inform the public concerning cancer, how they may associate with themselves the type of medical men who can help in the fight against cancer, and when I look at the group that we have had on the platform this morning, of the leaders in this fight against cancer who are giving of their time and their energies in this direction, and when I know that this organization itself in all its strength has the support of over 9,000 of its Fellows, it has the support of such organizations as the American Society for the Control of Cancer, other organizations, national and state, I cannot help being inspired with the very great hope that we will at least make some impression on the disease which we are fighting. I would like all who are here, who are interested in the clinics, to know that we at the central office in the Department of Clinical Research stand ready to offer every aid we can in the way of advice concerning the organization and administration of your clinics, that we will help in furnishing information concerning the ways in which other clinics are meeting difficulties which you may meet. I would like you to know too that we have the ever present help and advice of one of the strongest committees on cancer, who are constantly advising our department to place the information that they have at your disposal.

EPIPHYSEAL CHONDROMATOUS GIANT CELL TUMORS OF THE UPPER END OF THE HUMERUS[1]

ERNEST AMORY CODMAN, M.D., F.A.C.S., BOSTON

michuliez 1904.

GIANT cell tumors of the upper end of the humerus are either very rare or else they should include the nine tumors in the cases I am about to discuss, which in our series[2] have in some instances been called giant cell tumors and in others chondromata, or chondrosarcomata. Evidently a giant cell tumor affects the upper end of the humerus in a different way from that in which it affects the other long bones. Case 117 registered by Bloodgood is the only one which seems to resemble a typical giant cell tumor, and even in this case very little expansion of the bone is shown. There are two other cases, 4 and 556, which are perhaps pure giant cell tumors, but owing to the poor data we have received concerning them, they cannot be seriously considered. I do not know of a single case of typical giant cell tumor in which the growth has expanded the whole upper end of the humerus to the very cartilage of the joint, and which shows the typical trabeculæ which are observed in such tumors in other bones. Phemister tells me there is such a specimen at the Presbyterian Hospital in Chicago. It is my belief that the peculiar structure of the head of the humerus makes the picture of giant cell tumor so modified that typical cases do not often occur.

The type of case I allude to in the title is illustrated in the Registry Series by 9 tumors of the upper end of the humerus, involving only the portion of the bone in the region of the tuberosities. I wish to call attention to the fact that all the cases in this class are very atypical for either giant cell tumor or osteogenic sarcoma, and that they have a characteristic appearance both by X-ray and in the microscopic slide. It is of interest that the first case (Croxton, Registry 5) has recently been reported by Geschickter and Copeland as a sarcoma.[3] On the other hand, Kolodny has reported the same case as a giant cell tumor and illustrates his book with photomicrographs and X-rays from it (Figs. 88, 89, and 98). The last case in the group, 1031, has been recently reported by Phemister[4] as one of chondrosarcoma. Three of the other cases were registered by Coley. Since these men have given serious study to the subject, I cannot lightly take the position that their conclusions have been erroneous, and that in reality, their cases were not malignant but were benign giant cell tumors of this chondromatous type. However, the intermediate 7 similar cases in the Registry present such uniformity in the long history prior to operation, the ages of the patients, the good results following conservative treatment, and the unanimity of X-ray and microscopic appearance, that I am personally convinced that all the cases, theirs included, had essentially benign tumors. I believe that this group of tumors is a clinical entity which the surgeon should bear in mind when confronted with tumors of the upper end of the humerus.

In regard to one of these cases (391), of which we have no X-ray, registered by Coley, but which had been operated on in January, 1915, at the University of Michigan, Ewing wrote on the Registry Classification sheet as follows:

"Dec. 18, 1923. This appears to be one of the cases of giant cell tumor associated with the absorption of cartilage. *Such tumors are generally found at the head of the humerus.* The giant cells are rather numerous, typical epulis type, and most numerous about blood spaces. The accompanying cells are peculiar, and are rather large polyhedral granular cells occurring in sheets and clumps. In some areas the giant cells are missing and the polyhedral cells appear exclusively. There are several small foci in which there is dark, staining fibrillar or partly hyaline material, which appears to be degenerating cartilage. There may be some new formation of this imperfect cartilage. There is no sign of bone formation. It does not resemble any of the well known forms of osteogenic sarcoma. Tumor is relatively benign, but probably more active than most giant cell tumors."

The line in italics in which Ewing says, "such tumors are generally found at the head of the humerus," shows his recognition of this type of tumor. He has also alluded to them in his paper at the 1929 London Congress under the caption of "Calcifying Giant Cell Tumors," as follows: "I also feel that these tumors are essentially giant cell tumors, and that one must not be deceived by the appearance of chondrosarcoma which they give."

The much discussed Croxton case, Registry 5, was that of a boy of 16, registered by F. G. Bunts, Cleveland, one of the first cases in the Registry Series. There has been much argument about this case among those interested in the Registry. Bunts consulted Bloodgood and the case appears in Bloodgood's writings as P. N. 26792. Bloodgood favored a pre-operative diag-

[2] This study was made from the material collected by the Registry of Bone Sarcoma.

[3] Arch. Surg., 1930, May, pp. 731-733.

[4] Surg., Gynec. & Obst., 1930, I. 216.

[1] Presented in the Symposium on Cancer, before the Clinical Congress of the American College of Surgeons, Philadelphia, October 13–17, 1930.

nosis of benign tumor but changed this diagnosis to central sarcoma after seeing the specimen. Bunts, however, using his clinical judgment at the operation, decided to treat the case conservatively. He did a very thorough curetting of the tumor and packed with gauze; 8 days later he cauterized with zinc chloride, implanted radium, used postoperative X-ray and Coley's toxins. The patient has remained well. Geschickter and Copeland, in their recent article of 1930, still consider the case a sarcoma. In the early days of the Registry, it was considered sarcoma by Ewing, Mallory, Wolbach, Wright, White, Fox, Taylor, and Phemister. Later, Ewing and Bloodgood changed their opinions and agreed with Graham, Stout, Connor, Morton, and the writer, who had considered it a giant cell tumor. It seems to me that in consideration of the other 8 cases here presented and the outcome of this case that the diagnosis of giant cell tumor is the correct one. The 9 cases may be summarized as follows:

Registry 5. Bunts first saw the case May, 1919, 5 months after the boy had hurt his shoulder while wrestling. During these months, there was a history of the shoulder having slipped out of place and readily slipping back again into the socket. In the last 2 months there had been much pain, especially at night. There was also scapulohumeral spasm. Bunts first treated the shoulder conservatively with a rubber bandage, but in October, 1920, he had X-ray pictures taken which showed the tumor. He then consulted Bloodgood, and operated on October 11, 1920, one year and a half after the first symptoms. The patient was reported to be well 10 years later.

Registry 86. Registered by C. C. Simmons, of Boston. A boy of 13 years had had for 1 year, a hard, smooth tumor, the size of an egg. Curettage was done August 6, 1918. The X-ray picture which was typical of this kind of tumor was poor and was probably taken after curetting. The slide is a good example of this kind of tumor. It presents more giant cell tissue than some of the others. The giant cell tissue verges on the true giant cell tumor type. Patient was well in November, 1922. No further note.

Registry 174. Registered by Coley. No operation was done and hence no slides were made. Patient was a pregnant female, colored, aged 24 years. She was admitted to Memorial Hospital February 1, 1922. She had had pain, with increasing severity, for 6 months, and a tumor soon followed, July, 1921. The method of treatment was not stated. In August, 1930, Ewing reported that she was well. The notes were very brief. The X-ray is fairly characteristic of this type of tumor.

Registry 391. Registered by Coley, but had been operated on at the University of Michigan, in January, 1915. The patient, a boy of 15 years, had a tumor of the right shoulder. He was unable to raise his arm. Pain had been present for 8 months. He gave no history of injury. He was treated afterward with toxins. The slides show the characteristic appearance of these tumors. No X-ray. This is the case on which we quoted Ewing's pathological report. Well in October, 1923.

Registry 603. Registered by Coley. Male, aged 15 years, was admitted to hospital February 18, 1924. Six months ago he had pain in the right shoulder, followed by stiffness 3 months later, with some swelling. He had had electrical treatments with no relief. He was treated with X-ray by Herendeen, and was reported well in January, 1927. No slides were made. X-ray films in this case indicate a certain amount of separation of the greater tuberosity, but are fairly characteristic of the group. No history of injury was elicited.

Registry 815. Registered by W. A. Clark of Pasadena, California. A boy aged 20 years, colored, had pain in his arm which began in November, 1926. The arm was stiff. He was operated on March 10, 1927, at which time the entire upper end of humerus was resected. He was working in July, 1930. The X-ray was very typical, as was the microscopic slide.

Registry 816. Registered by E. T. Dickinson, Greenville, North Carolina. A girl of 17 years, about a year before entering the hospital, noticed a dull pain in the right shoulder. The pain had increased until she could barely use the arm at all. Abduction to more than 20 degrees was impossible. Operation was done October 5, 1926. The tumor was curetted and swabbed with zinc chloride. The supraspinatus and subscapularis were removed and sutured back to the rims of the head. After operation Coley toxins and X-ray treatment were given. She was well, with some limitation of arm movement, in August, 1930. X-ray pictures before and after operation were typical of this kind of tumor. The slides were very typical. There was more bone formation than usual. There were areas of giant cells mixed with cartilage and bone.

Registry 902. Registered by H. B. Thomas, Chicago Research Hospital. A girl of 14 years had had pain and difficulty in putting on her coat for a year. She gave no history of trauma. Some swelling was present. She had had some chiropractic treatments. She was operated upon by Hedblom, March 10, 1927, at which time the upper end of the humerus was excised. June 27, 1927, the upper end of the left fibula was transplanted. The wound healed with primary intention. She was well, August, 1930, with no sign of recurrence. The slide and the X-ray picture were very typical.

Registry 1031. Registered by D. B. Phemister, in August, 1919. Male, aged 22 years. Three and a half years ago, he had slight pain, followed by slight limitation. Operation was done 2 years ago, by another surgeon; the area of reduced density in the tuberosity being curetted. Symptoms soon recurred, a second curetting was done but no sections were made. Limitation of movement and pain became worse. Phemister resected the upper 6 inches of the humerus, and applied a bone graft in August, 1919. The outcome was successful, and the patient was well 8 years later. The X-ray is fairly typical of this condition and the slide is very typical. The relative proportion of chondromatous material to giant cells is greater than in the other cases, but this case was operated upon twice before, and had in the meantime passed the age of epiphyseal union.

SUMMARY OF NINE CASES

X-ray characteristics. These giant cell tumors or chondromata (?) of the upper end of the humerus lie in the angle between the upper and lower epiphyseal lines, i.e., in the greater tuberosity and are checked at the epiphyseal line of the articular head. Fractures of normal bones in this region are very apt to separate the portions of the bone at the lines of cleavage of the old epiphyses. It appears that in normal bone there is a line of cleavage separating the portion of the bone which

Registry No. 117.

Registry No. 103.

is covered with cartilage from the rest of the head, and that this line of cleavage persists long after the epiphyses have united. It may be this line of resistant bone which keeps these tumors from reaching the articular head. At any rate, these tumors do not, as do giant cell tumors in the neighborhood of other joints, actually destroy the bone to the very cartilage. Thus these tumors affect the bone after the manner of osteogenic sarcoma and one always sees in the X-ray picture a small portion of normal bone near the articular surface. This appearance in the lower end of the femur is very characteristic of an osteogenic sarcoma, but it should be discounted when it is found near the head of the humerus. In other words, these peculiar tumors break the rule of giant cell tumors in other bones of progressing through to the very cartilage of the joint, and in the head of the humerus do not extend much beyond the epiphyseal line.

They do not present the characteristic trabeculations which are seen in the X-ray picture of giant cell tumors in other bones. Instead they have a fluffy, "cotton-wool" look. After curettement, they present a fairly characteristic appearance, as if the tuberosities had been gnawed away, thus leaving the articular head and a very definite neck of bone on the inner side. Before curettement, the X-ray examination shows that there is a rather sharp line of demarcation separating the irregular, flocculent mass occupying the region of the greater and lesser tuberosities from the articular head, the inner portion of the neck of the humerus, and the rest of the shaft. A very characteristic feature in all the X-ray films is a buttress of apparently thick, normal, cortical bone on the outer portion of the shaft just below the tumor. This appearance suggests that the tumor has been of quite long duration and nature has supplied reactive bone to strengthen the cortex below it. There is also a thick endosteal layer of bone especially evident in Phemister's case 1031, which had been curetted twice before the resection. The outer buttress is not in appearance like the so-called "reactive triangle," in which there is a triangle between the raised periosteum and the old cortex. It is much more dense and extends much farther down the bone. The buttress is solid and is merely an increase of normal cortical bone, with no invasion of tumor tissue between the old cortex and the periosteum as we see in osteogenic sarcoma. All 9 of these tumors are comparatively small, none being twice as large as the normal head of the humerus.

Registry No. 5.

Registry No. 174.

Registry No. 603.

Registry No. 815.

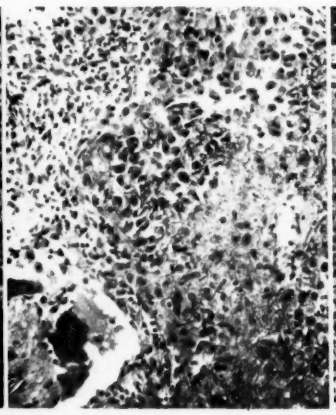
Registry No. 816.

Registry No. 902.

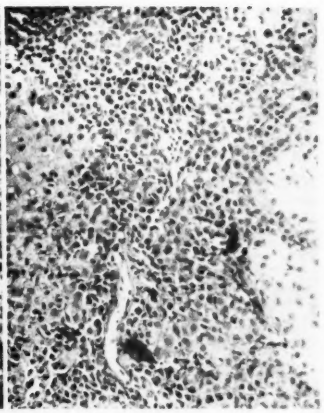
The microscopical appearances are chiefly distinguished by the presence of peculiar epithelioid cells which merge into a low grade type of cartilage cell on the one hand and into the cells of the tumor on the other. Sometimes the newly formed cartilage forms the bulk of the tumor, and sometimes a tissue indistinguishable from giant cell tumor occupies most of the space. The gross curettings are composed partly of red, friable tissue and partly of whitish, sago-like bits of material or frank cartilage. Sometimes the bulk of one of these tumors is almost wholly cartilage. Perhaps these instances are in slightly older patients, near or just beyond the age of epiphyseal union, e.g., Phemister's case 1031. Sometimes there is a deposit of calcium in the cartilage, and new bone formation. It is very likely that some cases may be complicated by infraction and callus.

We frequently find newly formed cartilage and bone toward the periphery of a giant cell tumor, and we sometimes see in giant cell tumors in other parts of the body small areas which corre-

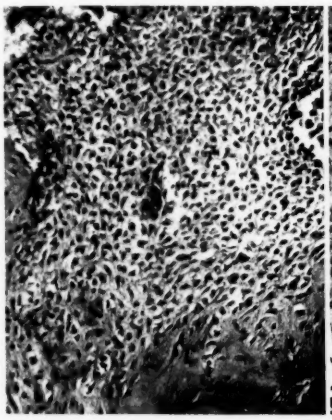
Registry No. 86.



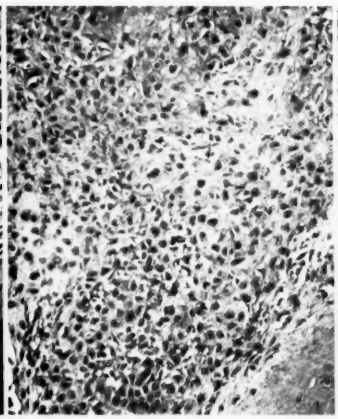
Registry No. 391.



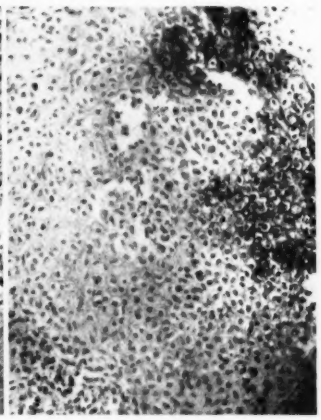
Registry No. 815.



Registry No. 816.



Registry No. 902.



Registry No. 1031.

spond to the peculiar tissue seen in these tumors of the humerus. However, we seldom see, in tumors of the other parts, the bulk of the tumor made up by this low grade cartilage and epithelioid cells.

Since we may find similar tissue in true osteogenic sarcomata which involve the epiphyseal lines in this region, it cannot be too strongly stated that the presence of this tissue does not prove that the tumor is benign. I merely wish to make the point that this peculiar tissue probably indicates a benign process and together with the characteristic X-rays and clinical history would justify conservative treatment. In fact, I believe that characteristic X-rays alone are sufficient evidence to justify the institution of radiotherapy without incision. It seems to me that there is reason to believe that if one of these patients were treated with the X-rays alone, the ultimate result would be better. Unfortunately, there are no detailed notes on the end-result of Case 174 which is the only one in which no incision was made.

Clinical points. The age may prove of importance in diagnosis, when we get a larger series. It is highly probable, as suggested by J. H. Wright, that this cartilage-like tissue is derived from the epiphyseal line. It will be observed that the ages in the cases here presented were in the neighborhood of the time when the epiphyseal lines were still present (given as 12 to 24, but the tumor must have begun earlier in each case). One must bear in mind, too, that the epiphyseal lines in the

region of the head of the humerus occupy a relatively larger part of the bone than do such lines in other situations, because there are three separate centers of ossifications: one for each tuberosity, and one for the head. The upper surface of the diaphysis, adjacent to the epiphyseal line, is cone-shaped.

Another clinical point is the relatively long history of symptoms prior to any operation, or the formation of a large tumor, i.e., at the least, 6 months and an average of over a year. It is of interest to us also that the early symptoms are very similar to those of subacromial bursitis, i.e., pain and restriction of motion. As I have never taken care of one of these patients myself, I cannot speak positively of the early symptoms, and the notes in our cases are very meager, but all mention pain and restriction. However, since these tumors lie just beneath the bursa, it is highly probable that they do produce a bursitis by crowding the enlarged tuberosities under the acromion. There should be a question of this diagnosis in all cases where symptoms of subacromial bursitis occur in persons under 20 years of age, for subacromial bursitis is rare at this time of life and these peculiar tumors occur only at this time of life.

Since all 24 patients with true osteogenic sarcoma of the head of the humerus are dead or very recently registered, a most important clinical point in the 9 cases reported here, is the history of recovery without amputation of the arm. In 3 of our cases curettements were done, excision was done in 1 case, resection including the head of the bone was done in 3 cases. The 2 others had no operations. Coley's toxins were also used in Registry cases 5, 174, 391, and 816.

I have described these cases in some detail for two reasons. First, because I believe they represent a subordinate clinical entity which should be recognized in the literature, and second, because they are among the few bone tumors which lie in direct contact with a part of the subacromial bursa and give bursal symptoms. In fact an operator could not thoroughly curette or excise one of them without opening the bursa. If the growth were malignant, one could hardly fail to leave some cells in the bursa. That 7 were thus curetted or excised with the bursæ opened (and probably also the joint), and extension of the disease did not result, seems strong evidence that the tumors were essentially benign.

Another point is that in our 9 cases the clinical judgment of the surgeons in charge was evidently in favor of conservative treatment, for no amputations were done in spite of the pathology.

Treatment. Since the cases are few in number and the treatment has been outlined in each case, the reader may take his choice of methods. I think I should incline toward mild X-ray therapy, but if I decided to operate, the procedure followed by Dickinson (Registry 816), appeals to me as the best, namely, to excise the tumor and to suture the short rotators to the defect in the head of the humerus. Unfortunately, we have no details about the function of the arm in these 9 cases. All are said to have useful limbs, but the degree of usefulness with and without bone grafts cannot be compared without examination of the individual cases.

It is highly probable that similar giant cell tumors may arise in patients between 10 and 20 years, in the region of the other skeletal epiphyses, especially in the homologous region of the great trochanter of the femur. I believe that case 277 is such an instance, although in the Registry it is carried as a case of osteogenic sarcoma.

TABLE I.—COMPARATIVE DATA OF THE NINE CASES

Registry No.	Age	Date of onset	Duration before treatment (Mos.)	X-ray	Slide	Nature of operation	Date of operation	Yrs. since onset	Date Last Note
5	16	5–19	18	+	+	Curettage	10–19–20	10	9–29
86	12	8–17	12	+	+	Curettage	8– 8–18	5	11–22
174	24	7–21	6	+	o	X-ray?	(?)	9	8–30
391	15	5–14	8	o	+	Curettage	1–29–15	8½	10–23
603	15	8–23	6	+	o	X-ray	2–12–24	3½	1–27
815	20	11–26	5	+	+	Resection	3–10–27	4	7–30
816	17	9–25	12	+	+	Excision	10– 5–26	5	8–30
902	14	2–26	12	+	+	Resection and transplantation	3–10–27	4½	8–30
1031	19	8–16	36	+	+	Resection and transplantation	8–19	14	1–30

With regard to the name by which to designate this type of tumor. I have used the adjective epiphyseal because I believe that these tumors are characteristic of the period of life when the epiphyses are uniting and that their peculiar cells arise from the epiphyseal cartilage. I have used the adjective chondromatous as descriptive of their histology. I believe that they are essentially benign giant cell tumors and thus that part of their name is justified. Yet I am not satisfied with such a long cumbersome name. Ewing speaks of them as calcifying giant cell tumors, but this does not seem to me descriptive enough. We must find a name which will not tie the tongue but it should associate adolescence with the puzzling type of lesion.

MUSCLE INVOLVEMENT IN BREAST CANCER

Its Relation to Primary Radium Treatment[1]

J. M. WAINWRIGHT, M.D., F.A.C.S., Scranton, Pennsylvania

IN this brief contribution I shall attempt to cover only a few important principles in the treatment of breast cancer.

INVOLVEMENT OF MUSCLE

Attention has already been called to the fact that muscle involvement is much more commonly found today than it was when the older methods of studying the disease in a piece of tissue weighing often 2 or 3 pounds by means of a section one-half inch or so square were practiced. When an adequate strip of muscle underlying a breast cancer is studied in relation to the primary growth on the same whole breast slide, the muscle is found to be involved in about 60 per cent of cases.

The significance of this from the prognostic standpoint is extremely important. In a series of cases which I have studied 156 showed muscle involvement. This number includes cases in which there was actual infiltration of muscle fibers and, what is the same thing from a clinical point of view, cases in which the microscope showed cancer cells lying within 2 millimeters of the muscle surface. The death rate in this group was very high. Of 121 patients operated on 18 months or longer ago, 96 have been traced. Of these 71 or 74 per cent are dead. Exactly one-half died within 18 months after operation. Only 5 of these 71 patients lived over 3 years and only 2 lived over 5 years. Of the 35 patients in the group with muscle involvement who are still alive after 18 months, 6 have known recurrences.

Figures 1 and 2 illustrate very well this important point in breast pathology. In the dense muscle tissue to the left in Figure 1, there are 10 nodules about one-sixteenth of an inch in diameter, and just above the arrow *A* diffuse infiltration of the muscle fibers is seen with the microscope. In Figure 2, at the arrow *A* is a nodule about one-eighth of an inch in diameter lying on the under surface of the muscle.

GLANDS ON THE ANTERIOR SURFACE OF THE PECTORALIS MAJOR

Attention has also been called to an important point in connection with the muscle, this is that the first stage of involvement for lymphatic glands in breast cancer is on the anterior surface of the muscle, not behind the muscle in the axilla

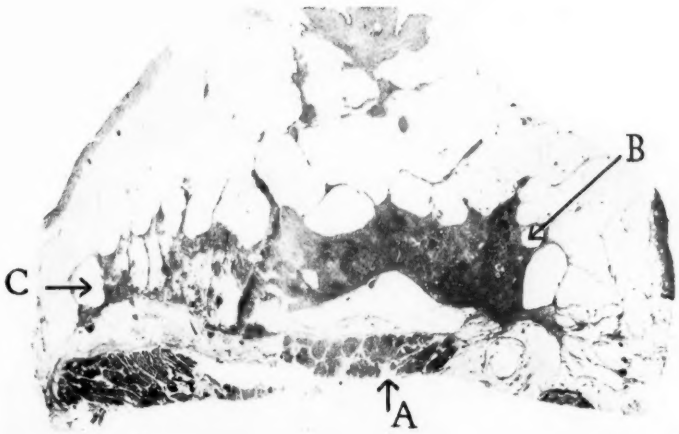


Fig. 1. B. M. 1689. About ¾ actual size of the slide. Dense area at *B* is the primary growth. Nodular area at *C* is extension of the disease to the extreme opposite edge of the breast. About 1¾ inches away, above the arrow *A* additional cancerous deposits can be seen by microscope.

[1]Presented in the Symposium on Cancer, before the Clinical Congress of the American College of Surgeons, Philadelphia, October 13–17, 1930.

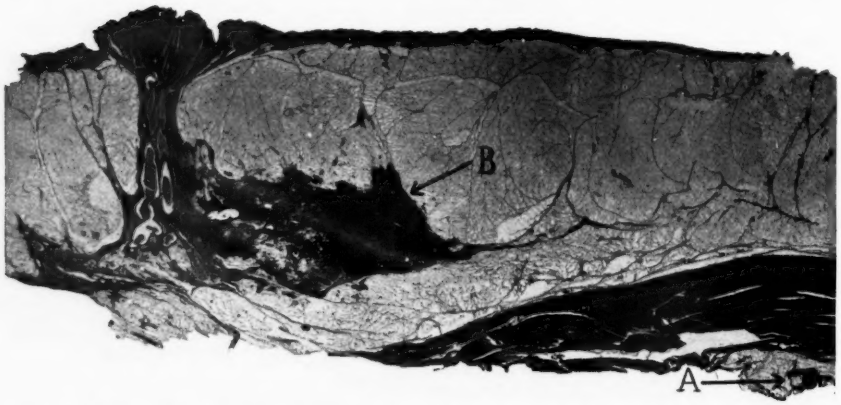


Fig. 2. B. M. 1338. *B*, primary tumor. At arrow *A* is a nodule ⅛ inch in diameter on the under surface of the pectoralis major muscle. Distant about 2 inches from the primary tumor.

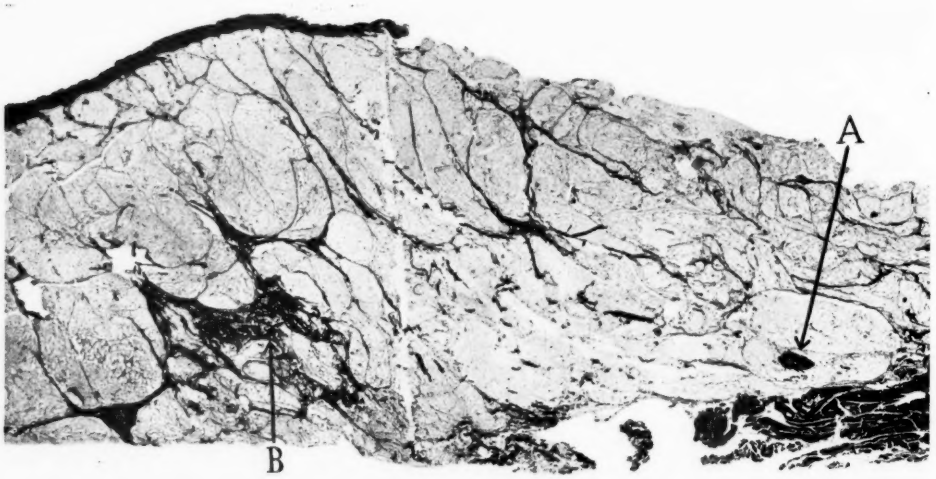


Fig. 3. B. M. 1112. Natural size. *B*, primary tumor. *A*, Lymph gland on the anterior surface of the pectoralis major muscle, distant about 2½ inches from the primary tumor.

as we have previously supposed. This is illustrated in Figure 3. These two facts—(a) the frequency of involvement of the underlying muscle and (b) the presence of lymph glands on the anterior surface of the muscle—have very cogent clinical applications.

First, if surgical removal is planned, the necessity of removing the pectoral muscles is clearly demonstrated. Also the necessity of carefully respecting the anterior surface of the muscle with its presumably involved glands and of removing the muscles by dissecting them away from behind, as advocated by Handley.

Second, they indicate a very definite limitation to the value of implanted radium or radon as the primary treatment in presumably operable cases.

Even if it is attempted to radiate the entire breast and the usual gland sites as advocated by Keynes and Sir Lenthal Cheatle, it seems distressingly probable that the nodules buried in the muscle in Figure 1, or the nodule on the posterior surface of the muscle in Figure 2, or the lymph

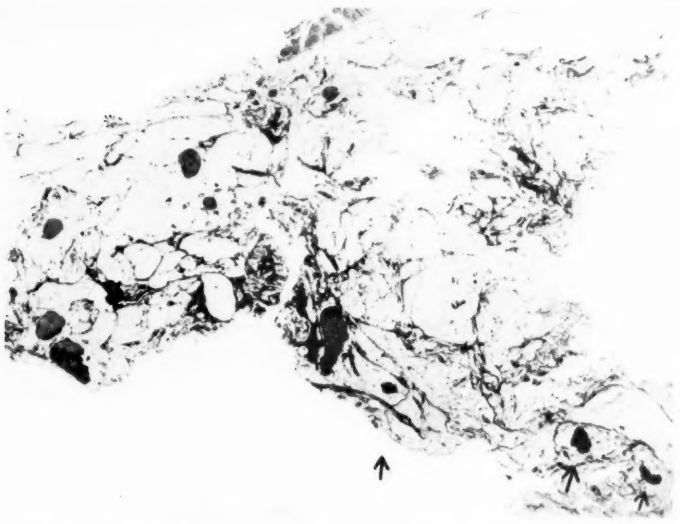


Fig. 4. B. M. 1337. About natural size. Ten tiny lymph glands. None palpable clinically. Barely perceptible on gross section. All but the 3 on the extreme right indicated by arrows are extensively involved.

Fig. 5. B. M. 1458. Five-sixths actual size. At the extreme right of the breast tissue there is a circumscribed primary cancer about 7/8 by 1/2 inches. To the left of the nipple at the arrow point is a secondary nodule about 1/16 inch in diameter and about 3 inches distant from the primary tumor.

gland on the anterior surface of the muscle in Figure 3, are so far distant from the tumor, or so well protected by muscle that they would not receive a killing dose of radiation, but live on unchecked or indeed perhaps be stimulated by a sublethal dose.

It should be remembered that the conditions illustrated in Figures 1, 2, and 3 are not unusual. Many similar cuts could be made from the writer's collection. The three figures are sufficient as examples.

AXILLARY GLANDS

Before passing from the question of axillary gland involvement, it is well to study for a moment Figure 4. This is a large slide of axillary fat showing 10 tiny axillary glands. All are too

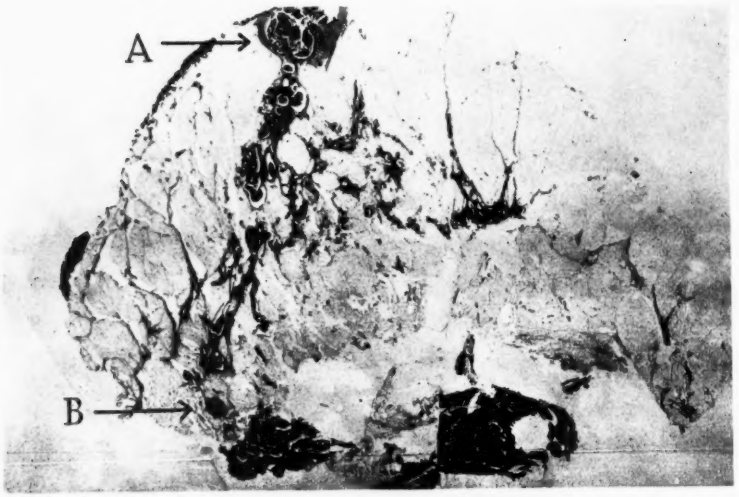


Fig. 6.

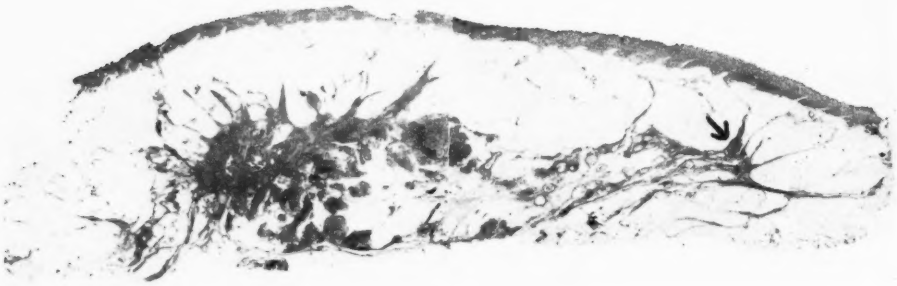


Fig. 7.

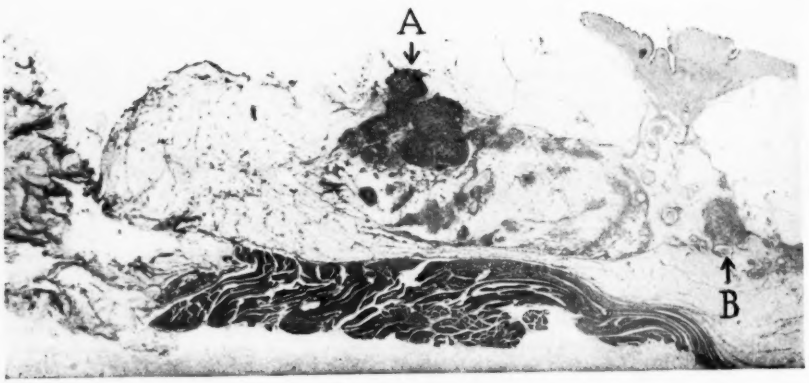


Fig. 8.
(Legends on opposite page.)

small to be palpated. Indeed, they could barely be appreciated on gross section. Yet of the 10 tiny glands, 7 are extensively involved microscopically. The teaching from this slide is that, no matter whether surgery or radiation is to be employed, the absence of clinically palpable axillary glands is not to be taken as an indication that treatment of the axilla is not to be exactly as careful in either case as though glands were definitely palpable.

DISTANT SECONDARY NODULES

In considering the general adoption of implanted radium or radon as the treatment for operable breast cancer, the not infrequent possibility of distant secondary deposits in the breast is of great importance. A few whole breast slides will illustrate this very clearly. Figure 5 shows a circumscribed primary cancer about ⅞ by ½ inch at the extreme right of the section. At the point of the arrow almost 3 inches away is a tiny secondary nodule. No matter how carefully the whole breast might be radiated, the chance that such a tiny nodule would receive a lethal dose is very small. Figure 6 is similar. This represents a duct system which has contained benign papillomata for many years. A nodule at *A* in the nipple has undergone malignant degeneration. Other nodules were not palpable in this breast and it would be a great temptation to treat this nipple by surface radiation. Yet at the arrow *B* is another equally malignant nodule over 2½ inches from the first. Again the chance of this nodule receiving a lethal dose either from surface radiation or a fortunately placed needle is small. Figure 7 is equally impressive. To the left is a large feathery cancer which might receive adequate radiation. Under the point *A* at the arrow is a secondary nodule, distant about 2 inches, which would probably escape. Figure 8 shows a primary growth to the left of the nipple, *A*. At *B* there is a secondary growth about 1½ inches distant which would probably escape implanted needles.

Considering the obstacles to be overcome in primary treatment of operable cases by radium implantation or by bomb arising (1) from distant secondary nodules in the breast, (2) from nodules buried deep in the substance of the pectoralis major muscle or even beneath it, (3) from glands on the anterior surface and edge of the muscle as well as behind it, in the axilla and above the clavicle, it is doubtful if implantation by methods now available offers as good a chance of destroying all malignant cells as does radical surgical removal.

The lump in the breast is only one focus. The real theater of war, in any part of which other foci may be present, is a complete quadrant of the body extending from the umbilicus upward to above the clavicle and from the midline outward to the pectoralis major insertion.

SUMMARY

Whole breast sections have been shown to prove:

1. The involvement of the pectoral muscles.
2. The presence of lymph glands on the anterior surface of the muscle.
3. Many axillary glands may be involved before one can be felt.
4. The frequent presence of impalpable secondary nodules in distant portions of the breast or surrounding tissues.
5. These facts in breast pathology demand: first, if surgery is to be employed, widespread removal of tissue from the entire quadrant of the trunk involved, as laid down by Halstead, Meyer, and later developed by Handley; second, caution in adopting the view that these widely spread secondary deposits or metastases can adequately be reached by radium implantation.

Fig. 6. B. M. 1352. About 7/10 actual size. A duct system with intraductal papillomata undergoing malignant change at *A* in the nipple and at *B* almost on the surface of the muscle and 2½ inches away.

Fig. 7. B. M. 1481. Feathery cancer near center of breast. At the extreme edge of the breast is a secondary malignant nodule marked by arrow.

Fig. 8. B. M. 1185. About actual size. Primary growth at *A*. Secondary nodule about 2 inches away at *B*.

HOW SOON SHOULD COLOSTOMY BE PERFORMED IN CASES OF INOPERABLE CANCER OF THE RECTUM[1]

WILLIAM ERNEST MILES, F.R.C.S., London, England

BY an inoperable case is meant not only one in which the disease is so far advanced that complete removal is impossible, but also one in which, even though the growth be comparatively restricted, the age of the patient or his unfavorable general condition renders a radical operation too great a risk to life. Under these circumstances we are often called upon to decide whether the operation of colostomy should be deferred until the patient experiences pronounced difficulty in evacuating the contents of the bowel. The matter is not easily disposed of, for not only the patients themselves but also their medical advisers regard colostomy as a calamity which should be postponed as long as possible. The argument usually advanced is that there will be time enough to resort to it when life is in danger from an impending attack of absolute obstruction. Such a contention as this would be reasonable if an attack of absolute obstruction supervened at a definitely known period during the course of the disease and if the premonitory symptoms were always gradual in development. Unfortunately, however, in some cases the attack occurs rapidly and without warning, though in others its advent may be long delayed. Moreover, in the interim, be it short or long, many complications may arise during the progress of the disease which materially increase the suffering of the patient and which a timely colostomy would greatly relieve or entirely obviate.

Since the site of the growth in the rectum has considerable influence both on the time of onset of absolute obstruction and upon the nature of the other complications, it is necessary that we consider whether colostomy ought to be performed early or late in cases of cancer situated (a) at the rectosigmoidal junction, (b) in the ampulla, and (c) in the anal canal.

GROWTHS SITUATED AT THE RECTOSIGMOIDAL JUNCTION

When carcinoma occurs at the rectosigmoidal junction it conforms to the type generally met with in the colon, in that it spreads rapidly round the whole of the circumference of the bowel and produces stenosis. In these cases the earliest symptom to attract attention is increasing difficulty in the movement of the bowels. Alternating attacks of constipation and diarrhœa, which herald the early onset of absolute obstruction, soon make their appearance. When such a case, for some reason or other, is found to be inoperable, should colostomy be done at once, or should it be deferred until it becomes absolutely necessary to avert death from complete obstruction? The answer is to be found in the records of our experience of the complications that may arise during the progress of these cases before the onset of obstruction. In the first place, diarrhœa may be so persistent as to necessitate relief of the bowels many times during the day and night. The patient suffers great distress and rapidly loses ground from having his rest disturbed. Again a growth situated in this locality, besides causing stenosis, may penetrate the wall of the bowel and produce a weak spot which gives way under the strain of violent peristalsis.

Lastly, an attack of absolute obstruction may be precipitated suddenly and without previous warning, either from the stenosed segment of bowel becoming intussuscepted into the lumen of the bowel below, or from a large mass of fæces having become impacted above the growth. In either case, colostomy must be performed under the most disadvantageous circumstances, and, in some instances, may not be possible at all owing to distension of the colon with solid fæces.

GROWTHS SITUATED IN THE AMPULLA OF THE RECTUM

Owing to the large diameter of the bowel in this situation an attack of absolute obstruction does not take place until the disease has reached a very advanced state, and, indeed, in a considerable number of cases it does not occur at all. Hence, if colostomy is postponed until signs of obstruction are impending, the patient will have endured much misery from various complications which earlier intervention would have spared him. It is not only in advanced cases, however, that the expediency of early colostomy has to be considered. It may happen that, owing to an unfavorable condition of a patient, a carcinoma in quite an early phase of development cannot be removed.

Let us now consider the case of a growth in a more advanced phase of development, and let us suppose, for example, that the growth has involved one half of the circumference of the bowel. At this period the process is not sufficiently exten-

[1] Presented in Symposium on Cancer, before the Clinical Congress of the American College of Surgeons, Philadelphia, October 13–17, 1930.

sive to cause much narrowing of the lumen of the bowel and the risk of the occurrence of an attack of absolute obstruction is very slight; the bowels act every day and there is no evidence of abdominal distension. Still, by the time a growth has involved half of the circumference of the bowel, surface disintegration is well marked and a state of active ulceration has been reached. Submucous suppuration is apt to occur in the vicinity of the margin of the ulcer, causing the patient considerable discomfort. He complains of pain in the rectum itself and over the lower part of the sacrum and is troubled with severe tenesmus at each action of the bowels. The ulcerative process is also accelerated by infrequent passage of fæcal material over it and often becomes covered with sloughing tissue. When these sloughs separate, free and copious hæmorrhage occurs. Such attacks of bleeding, when repeated, soon sap the patient's vitality. By the time, too, that a growth has encompassed half of the circumference of the bowel, penetration of the whole thickness of its coats has probably occurred, and consequent leakage into the perirectal tissues takes place. This leads to the formation of pus in the pelvirectal space. Such abscesses usually evacuate themselves into the rectum, but sometimes they invade the ischiorectal fossæ, not infrequently terminating in fistulæ with numerous external openings in the perineum from which pus continually escapes. These fistulæ require repeated operation, but seldom heal, and often become the seat of fungating growth, which adds immensely to the misery of the patient. The pain and the repeated hæmorrhages during this stage of an ampullary carcinoma are practically abolished, and the formation of abscess and fistula is entirely prevented by early colostomy.

Even during a later stage, when the growth has entirely encircled the bowel, an attack of absolute obstruction may not occur. By this time the carcinoma has extended into the perirectal tissues, has involved neighboring structures, and has involved the sacral plexus of nerves. The condition of the patient is now truly miserable, and colostomy, if performed, holds out little prospect of relief. Moreover, though actual obstruction may not exist, the pelvic colon is probably so distended with fæcal material that it is impossible to withdraw a loop of gut from the abdomen in order to obtain an efficient spur.

GROWTHS INVOLVING THE ANAL CANAL

A carcinoma in this situation is from the onset accompanied by severe pain at every action of the bowels. This is due partly to greater sensitiveness of the mucosa of the anal canal and partly to spasm of the sphincter and levator ani muscles. It is true that this pain can be relieved considerably by operation of linear proctotomy, but in that case the misery of incontinence is substituted. The growth, too, very rapidly penetrates the coats of the bowel when ischiorectal suppuration with external fistulæ results. Colostomy in these cases affords complete relief especially if combined with linear proctotomy.

Thus when a case of cancer of the rectum, in whatever position it may occur, is considered to be inoperable, the sooner colostomy is performed the better it will be for the patient. By so doing he is saved much unnecessary suffering from the various complications that may arise before an attack of obstruction supervenes and renders the operation necessary. From my experience of these cases I am convinced that, as soon as carcinoma of the rectum is found to be inoperable, every day lost before resorting to colostomy is a day to the bad.

ELEVEN YEARS' EXPERIENCE WITH THE RADIUM TREATMENT OF CARCINOMA OF THE CERVIX, AT THE WOMAN'S HOSPITAL

A Statistical Report[1]

GEORGE GRAY WARD, M.D., F.A.C.S., and LILIAN K. P. FARRAR, M.D., F.A.C.S., New York

At the Woman's Hospital we have been treating carcinoma of the cervix with radium since February, 1919, and we have published our 5-year results in 1925 and again in 1928. We now have two more 5-year series to report, making 6 series in all, covering a period of over 11 years.

During the first year our technique was not systematized and was therefore variable and was sometimes combined with surgery, but since 1920, we have consistently followed a technique that we have developed. This technique we have previously published in detail, the essential features being: the preliminary building up of the patients' resistance when indicated, an initial dosage of radium of 2,400 to 4,200 milligram hours, a meticulous post-radiation care of the patient, with a personal monthly follow-up throughout the entire 5-year period, with subsequent re-radiations whenever the follow-up examination disclosed evidences of beginning recurrence within reach. We have not used the high voltage X-ray therapy as an adjunct until the past year, so this factor does not enter into the 6 series reported.

Our technique has proved so satisfactory in the results obtained that we have not changed the procedure throughout this period. Our experience has led us to believe that improving the patients' resistance before the irradiation in cachectic cases is of distinct advantage in enabling the patient to pass through the period of post-radium reaction safely. Therefore whenever possible, every patient with red cells less than 3,500,000 and hæmoglobin 50 per cent or below, is given a blood transfusion prior to the application of radium. The effect of radium is to produce a leucopenia, and a patient's resistance should be increased to combat this.

Cancer stays as a local condition for a long period of time, and this gives us an opportunity to fortify the patient's resistance mechanism, enabling her to combat the sepsis which is so frequent a sequel due to the absorption of post-radiation slough.

We have found spinal anæsthesia, a half dose only being necessary, more desirable as a rule than a general anæsthetic in this type of patient for the insertion of the radium. Potassium permanganate douches and an elevated posture are begun at once to favor drainage and separation of any post-radiation slough.

The value of the personal follow-up each month we believe cannot be overestimated. In no other way is it possible to detect early recurrences as manifested by small nodules or erosions long before the patient is aware of any subjective symptoms. Thus we are enabled to give a re-radiation with tube or needle in time to check the recurrence while in its incipiency. Pyometra which is not uncommon as a post-radiation complication may also be recognized early and be promptly relieved.

In this report we have had professional statisticians make a study of all our cases of carcinoma of the cervix from February 25, 1919, when we began to use radium, until May 15, 1930. During this period we have seen 259 cases; 8 of these were refused radium treatment because of a hopeless condition, and 251 patients were treated with radium (Table I). Of these 251 cases the disease was limited to the cervix in 65 (Class I and II, Schmitz), an operability rate of 25.9 per cent. In 186, the disease had extended beyond the cervix (Class III and IV, Schmitz), an inoperability rate of 74.1 per cent (see Table II).

The ages of the patients ranged from 24 years to 76 years. There were 15 patients under 30 years of age (see Table III).

Our primary mortality in 361 radium applications was 4 deaths or 1.1 per 100 applications. There were no deaths in the Class I and II cases (see Table IV).

The 5-year end-results of these cases is shown in Table V with 64 living patients, giving an absolute cure rate of 24.7 per cent and a relative cure rate of 25.5 per cent.

Table VI shows the number of patients living beyond the 5-year period.

Of the 251 cases, 170 were treated only by the technique we have developed, and previously mentioned, as shown by Table VII. In this group of 170 patients which were treated by this method, 79.4 per cent were suffering from an advanced type of the disease (Class III and IV) as compared to 63 per cent in the 81 other cases (see Table VIII).

[1] Presented in the Symposium on Cancer, before the Clinical Congress of the American College of Surgeons, Philadelphia, October 13–17, 1930.

TABLE I.—RADIUM OPERABILITY OF CASES OF CARCINOMA OF THE CERVIX UTERI, WOMAN'S HOSPITAL—FEBRUARY 25, 1919, TO MAY 15, 1930

	Number	Per cent of total
Total cases seen*	259	....
Cases treated with radium	251	96.9
Cases refused radium treatment	8	3.1

*Does not include 3 cases under treatment at other hospitals, 1 case leaving hospital without discharge, and 1 case admitted and operated upon before carcinoma was recognized.

TABLE II.—OPERABILITY OF CASES OF CARCINOMA OF CERVIX UTERI, TREATED AT THE WOMAN'S HOSPITAL—FEBRUARY 25, 1919, TO MAY 15, 1930

	Number of cases	Per cent of total
Total	251	100.0
Operable (limited to the cervix)	65	25.9
Class I (Schmitz classification).	3	1.2
Class II (Schmitz classification).	62	24.7
Inoperable (extended beyond the cervix).	186	74.1
Class III (Schmitz classification)	175	69.7
Class IV (Schmitz classification)	11	4.4

TABLE III.—AGES OF PATIENTS TREATED WITH RADIUM FOR CARCINOMA OF THE CERVIX UTERI, WOMAN'S HOSPITAL—FEBRUARY 25, 1919, TO MAY 15, 1930

	Cases
Total	251
20 to 29 years	15
30 to 39 years	51
40 to 49 years	84
50 to 59 years	61
60 to 69 years	29
70 to 79 years	11

Youngest, 24 years; oldest, 76 years.

TABLE IV.—PRIMARY MORTALITY OF RADIUM TREATMENT FOR CARCINOMA OF THE CERVIX UTERI, WOMAN'S HOSPITAL—FEBRUARY 25, 1919, TO MAY 15, 1930

	Radium insertions	Deaths in hospital	Deaths per 100 applications
Total	361	4	1.1
Class I	2	0	0
Class II	74	0	0
Class III	271	2	.7
Class IV	14	2	14.3

Note: 251 cases had 361 radium applications.

Table IX shows the 5-year end-results of all cases and the group treated only by our technique. This gives us an absolute cure rate of 24.7 per cent of all cases seen, and a relative cure rate of 25.9 per cent, although this group had a higher percentage of Class III and IV cases than the other as shown in Table VIII.

TABLE V.—FIVE-YEAR END-RESULTS OF CASES OF CARCINOMA OF THE CERVIX UTERI TREATED WITH RADIUM, WOMAN'S HOSPITAL—FEBRUARY 25, 1919, TO MAY 15, 1930

Series	Cases treated	Living	Per cent living 5 years
Total seen....259	...	64	24.7*
Total treated	251	64	25.5†
Before May 15, 1919	15	0	....
May 15, 1919, to May 15, 1920	40	7	17.5
May 15, 1920, to May 15, 1921	35	12	34.3
May 15, 1921, to May 15, 1922	33	7	21.2
May 15, 1922, to May 15, 1923	40	15	37.5
May 15, 1923, to May 15, 1924	39	12	30.8
May 15, 1924, to May 15, 1925	49	11	22.4

*Absolute cure rate.
†Relative cure rate.

TABLE VI.—END-RESULTS OF CASES OF CARCINOMA OF THE CERVIX UTERI BEYOND FIVE YEARS, WOMAN'S HOSPITAL—CLASSES I, II, III, IV

End-results	Cases treated	Cases living	Per cent living
5-year	251	64	25.5
6-year	202	45	22.3
7-year	163	33	20.2
8-year	123	22	17.9
9-year	90	16	17.8
10-year	55	6	10.9
11-year	15	0	0

TABLE VII.—PROPORTION OF CASES TREATED BY WARD AND FARRAR METHOD, WOMAN'S HOSPITAL—FEBRUARY 25, 1919, TO MAY 15, 1930

	Number of cases	Per cent of total
Total cases treated	251	100.0
Cases treated by Ward and Farrar method*	170	67.7
Other cases	81	32.3

*Does not include cases with other previous or subsequent treatment or operation, or cases first treated previous to May, 1920, when method was not systematized.

In this group of 170 patients of all classes of the disease, 44 were living at the end of the 5-year period, or 25.9 per cent; of the Class I and II cases (limited to the cervix) of which there were 35, 20 were living or 57.1 per cent; of the 135 Class III and IV cases (advanced beyond the cervix), 24 were living, or 17.7 per cent (see Table X).

Table XI shows those surviving beyond the fifth year in the group treated only by our method. It is interesting to note that in the 9-year period of 27 patients, 7 were salvaged, or 25.9 per cent.

In Table XII the percentage of living cases in this group is given according to the age of the patients.

TABLE VIII.—PROPORTION OF CLASS I AND II CASES IN GROUP TREATED ONLY BY WARD AND FARRAR METHOD COMPARED WITH GROUP WITH PREVIOUS OR SUBSEQUENT TREATMENT OR OPERATION, WOMAN'S HOSPITAL—FEBRUARY 25, 1919, TO MAY 15, 1930

	Cases treated by Ward and Farrar method only		Other cases	
	Number	Per cent	Number	Per cent
Total	170	100.0	81	100.0
Class I and II	35	20.6	30	37.0
Class III and IV	135	79.4	51	63.0

TABLE IX.—FIVE-YEAR END-RESULTS OF ALL CASES AND CASES TREATED BY WARD AND FARRAR METHOD ONLY, WOMAN'S HOSPITAL—FEBRUARY 25, 1919, TO MAY 15, 1930

	Cases treated	Cases living	Per cent living
All cases seen	259	64	24.7*
All cases treated	251	64	25.5†
Cases treated by Ward and Farrar radium method only	170	44	25.9†

*Absolute cure.
†Relative cure.
Note: When these figures were given at the meeting of the American Gynecological Society in May, 1930, we had traced 63 living. Since that time a patient reported at the Follow-up Clinic in good health, who had been previously recorded as dead, thus improving our percentages as here given.

TABLE X.—FIVE-YEAR END-RESULTS TREATED BY WARD AND FARRAR METHOD, WOMAN'S HOSPITAL—MAY 15, 1920, TO MAY 15, 1930

	Cases treated	Cases living	Per cent living
Classes I, II, III, IV	170	44	25.9
Classes I and II (limited to the cervix)	35	20	57.1
Classes III and IV (advanced beyond the cervix)	135	24	17.7

TABLE XI.—END-RESULTS OF CASES OF CARCINOMA OF THE CERVIX UTERI BEYOND FIVE YEARS TREATED ONLY BY THE WARD AND FARRAR METHOD, WOMAN'S HOSPITAL—CLASSES I, II, III, IV

End-results	Cases treated	Cases living	Per cent living
5-year	170	44	25.9
6-year	125	29	23.2
7-year	90	19	21.1
8-year	55	11	20.0
9-year	27	7	25.9

TABLE XII.—FIVE-YEAR END-RESULTS FOR VARIOUS AGES—CASES TREATED WITH RADIUM FOR CANCER OF THE CERVIX UTERI BY THE WARD AND FARRAR METHOD—WOMAN'S HOSPITAL—MAY 15, 1920, TO MAY 15, 1930

	Cases treated	Cases living	Per cent living
Total	170	44	25.9
20 to 29 years	9	2	22.2
30 to 39 years	31	13	41.9
40 to 49 years	56	13	23.2
50 to 59 years	42	12	28.6
60 to 69 years	23	3	13.0
70 to 79 years	9	1	11.1

TABLE XIII.—END-RESULTS OF CASES RECEIVING RE-RADIATIONS FOR CARCINOMA OF THE CERVIX UTERI, WARD AND FARRAR METHOD—WOMAN'S HOSPITAL—MAY 15, 1920, TO MAY 15, 1930

Treatments per case	Cases treated	Cases living 5 years	Per cent living
Total	170	44	25.9
1 treatment	87	22	25.3
2 treatments	55	15	27.3
3 treatments	20	4	20.0
4 or more treatments	8	3	37.5

The outstanding feature of our method of treatment is re-radiation whenever our monthly follow-up reveals evidence of recurrence in the vaginal tract, during the entire period of 5 years' observation.

Table XIII shows the number of re-radiations given the 170 patients. It will be noted that nearly 50 per cent had repeated treatments. This observation is of interest because repeated applications of radium after the initial treatments are not the practice in most radium clinics.

In the 251 cases treated we were able to trace all but 9, or a completed follow-up of 96.4 per cent.

While at the present time the question of radium versus surgery in the treatment of operable cervical cancer is by no means settled, we believe that advocates of radium in operable cases have a strong position in view of the results which may be obtained with this class of patients.

Fifty-seven and one-tenth per cent, with no primary mortality, compares favorably with Bonney's recent report of his results with the Wertheim operation in which he had in 284 cases a relative cure rate of 38.7 per cent, with a primary mortality of from 8 to 16.5 per cent, even though we take into consideration the fact that he operates on many cases where the disease has extended beyond the cervix.

Furthermore, we must bear in mind that while a Wertheim or a Bonney may achieve these exceptional results after years of experience and practice in developing this very specialized surgery, the average general surgeon operating on

carcinoma of the cervix obtains no such results and has a high primary mortality and morbidity.

On the other hand while safe radium therapy necessitates a thorough knowledge of the dangers and limitations of this powerful remedy and requires experience for its successful application, these requisites are within the reach of a much larger number than can hope to aspire to the necessary skill required for a proper Wertheim technique and in much less time. We must also remember that operative technique in the best hands has probably reached its zenith, while irradiation technique is only beginning and is not yet perfected.

In frankly inoperable cases radium has no rival at the present time. Our absolute cure rate of 24.7 per cent is about equal to Bonney's 24.4 per cent, and in our Class III and IV cases we have salvaged 17.7 per cent.

The combined method as practiced by Stockel and others of using radium followed by a Schauta operation of vaginal hysterectomy and X-ray has not yet been proved to give better results. More time is necessary before this can be demonstrated. The primary mortality will still remain as an objection to the combined method however.

CONCLUSIONS

1. Our experience of over 11 years with radium therapy in carcinoma of the cervix leads us to believe that the best results can be obtained with the smaller dosages of radium (2,400 to 4,200 milligram hours) provided a frequent personal follow-up is maintained throughout the entire 5-year period, and that re-radiations are given for local recurrences in their incipiency.

2. We believe that the response to the irradiation will be more satisfactory in result, with much less morbidity, if cachexia and anæmia (below 3,500,000 reds and 50 per cent hæmoglobin) are combated with a preliminary fortification of the patient's resistance by a blood transfusion.

3. We believe that the importance of post-radiation care, frequent cleansing douches, outdoor air, proper nourishing diet, rest, etc., should be recognized and carried out as far as possible.

4. We hope that future results will show that the high voltage X-ray therapy will take care of the 40 per cent gland involvement in the advanced cases, as found by Bonney. Without high voltage X-ray, our absolute cure rate of 24.7 per cent compares favorably with Bonney's 24.4 per cent.

5. Until the combined method as advocated by Stockel, Zweifel, and others shows better results in spite of primary mortality, we prefer to employ irradiation *alone* in carcinoma of the cervix.

6. We believe that in all cases in which the disease has advanced beyond the cervix only radium and X-ray should be employed and not surgery, even though many of these patients can be operated upon successfully, because our results with radium in these advanced cases are fully equal to those salvaged by the surgery of experts and without its high primary mortality and morbidity.

7. We believe that the results we have obtained with radium for the Class I and II cases, 57.1 per cent, without primary mortality or morbidity, are so close to the best results obtained by the Wertheim operation done by experts after years of specialized surgery in this field, that the radium method of treatment is obviously preferable to surgery in this class of case.

REFERENCES

1. Bonney. Lancet, 1930, p. 277.
2. Farrar. Am. J. Obst. & Gynec., 1925, x, 205.
3. Idem. Surg., Gynec. & Obst., 1926, xliii, 719.
4. Ward and Farrar. J. Am. M. Ass., 1925, lxxxv, 159.
5. Idem. Am. J. Obst. & Gynec., 1926, xi, 439.
6. Idem. J. Am. M. Ass., 1928, xci, 296.
7. Ward. Brit. M. J., 1928, ii, 607.
8. Idem. Am. J. Obst. & Gynec., 1929, xvii, 8.
9. Idem. Bull. Am. Coll. Surg., 1929, Jan.

CONFERENCE ON TRAUMATIC SURGERY

THE PURPOSE OF THIS CONFERENCE[1]

FREDERIC A. BESLEY, M.D., F.A.C.S., Waukegan, Illinois
Chairman, Board on Industrial Medicine and Traumatic Surgery

THIS is the fourth conference that has been held by the American College of Surgeons on the subject of Traumatic Surgery and Industrial Medicine and it is a fitting observation that in this era of mechanization in all lines of production and transportation there is an ever increasing number of injuries which circumstances naturally elicit and broaden the interest and the activities of the surgical and medical profession in this department of their art.

Special emphasis should be made that these conferences are in no way intended to create a new specialty in surgery or to develop the so-called traumatic or industrial surgeons, for the correct conception and thought is that these injured cases can be and are best cared for by the men well trained in general surgery. The essential purpose of these meetings is to bring about a more comprehensive understanding and a better relationship between the profession and that part of lay society which has a vital and community interest in the care of the injured. This in particular applies to the employers who are responsible for a large number of employees and insurance companies carrying the compensation risks. In a word the object is to carry a service to all those essentially concerned.

If some of the signs of an apparently rapidly changing relationship between organized medicine and the laity are correctly interpreted, it means that medical and surgical groups must develop a statesmanship capable of influencing the methods of practice from its economic side or lay bodies will usurp what they are coming to believe are their prerogatives.

In preparing this program it was the thought that more time should be devoted to the purely scientific problems involved in the care of the injured and to that end there will be discussed many phases of traumatic surgery by men whose experience, training, and observations fit them to speak with authority.

[1] Presented in the Conference on Traumatic Surgery, before the Clinical Congress of the American College of Surgeons, Philadelphia, October 13–17, 1930.

HOSPITAL PROBLEMS ARISING OUT OF THE CARE OF HIGHWAY ACCIDENT CASES[1]

EMIL FRANKEL, TRENTON, NEW JERSEY
Director of Research, New Jersey State Department of Institutions and Agencies

PERSONS cared for as in-patients in general hospitals because of injuries received in highway accidents numbered between 200,000 and 250,000 in the United States in 1929. Their total hospital maintenance costs amounted to between $15,000,000 and $16,000,000. In the same year the financial losses to the hospitals caused by the non-payment of hospital bills rendered in highway accident cases amounted to between $6,000,000 and $7,000,000.

These estimates are based upon figures secured in a state-wide survey[2] conducted by the Research Division of the New Jersey State Department of Institutions and Agencies with a view of obtaining facts that would throw light upon the hospital problems arising out of the care of highway accident cases.

RESULTS OF NEW JERSEY SURVEY

The data obtained from 19 representative general hospitals in New Jersey, which showed for each patient the type of care given, the number of days spent in hospital, the amount of the hospital bill rendered and the amount paid, may be summarized as follows:

1. A total of 1,781 patients with 22,440 hospital days represented an average stay of 12.6 days per patient. Of the total of 22,330 patient days, 5,063, or 23 per cent, were classed as private and semiprivate days and 17,377, or 77 per cent, as ward days.

2. To the 1,781 patients were rendered bills totaling $106,089, an average of $59.57 per patient and $4.73 per patient day.

3. Of the total hospital bill of $106,089, the hospitals have been able to collect only $59,530, or 56 per cent, the difference of $46,559 remaining unpaid. The majority of the hospitals reporting do not expect to recover even a small portion of the amount unpaid.

ACCIDENT CASES LOOM LARGE

The care of highway accident cases is beginning to loom comparatively large in the total hospital service. The records of 10 general hospitals selected at random show that 4.3 per cent of all the in-patients treated during the year were highway accident cases and that 5.4 per cent of the total patient days served went to the care of the victims of highway accidents. In these same hospitals industrial accident cases have receded somewhat in importance, representing 2.4 per cent of the total patient list and 3.1 per cent of the total patient days.

In a number of hospitals, highway accident cases constituted a larger number of patients and patient days than the average for the group of hospitals indicates. In one hospital, 8.1 per cent of all patients were highway accident cases and in two others the percentages of highway accident patients were 16.5 and 16.6 of the total number, respectively. Considering patient days, three hospitals recorded between 7 and 8 per cent of their total patient days as having been rendered to highway accident cases, one recorded 9 per cent and one over 10 per cent.

TIME SPENT IN HOSPITALS

A study of the time that 1,200 persons injured in highway accidents spent in hospitals shows that 51.8 per cent stayed less than a week, 13.7 per cent one day, 33.5 per cent from 1 to 3 days and 18.3 per cent from 4 to 7 days, and 17.3 per cent of the patients stayed from 1 to 2 weeks. On the other hand, the hospital duration of 13.5 per cent of the highway accident cases was from 2 weeks to 1 month, 11 per cent from 1 month to 2 months, and 6.4 per cent from 2 months upward.

That highway accidents leave in their wake more than one hospital patient, bed as well as ambulant cases, is indicated by a special study made by one hospital. This study showed that 114 accidents resulted in a total of 251 hospital patients of which 59 per cent were bed patients and 41 per cent ambulant cases, and that 71 per cent of the 114 accidents resulted in one patient, 22 per cent resulted in from 2 to 5 patients and 7 per cent resulted in from 9 to 22 patients.

AMOUNT OF HOSPITAL BILLS

While the average amount of the hospital bills rendered to highway accident patients in New Jersey was relatively low—$59.57—the amounts of individual bills ranged from less than $25 to

[2] Survey conducted for the New Jersey Commission to Study State and County Aid to General Hospitals, of which Dr. George O'Hanlon, Medical Director, Jersey City Hospital, was chairman and Dr. William J. Ellis, Commissioner, New Jersey State Department of Institutions and Agencies, a member.

[1] Presented in the Conference on Traumatic Surgery, before the Clinical Congress of the American College of Surgeons, Philadelphia, October 13–17, 1930. (For discussion, see p. 662.)

more than $500. Of the bills presented to highway accident patients, 45 per cent of the total was less than $25 in amount, 21 per cent ranged between $25 and $50, 22 per cent, between $50 and $150, and 11 per cent reached $150 or more. The hospital's ability to collect from highway accident patients varied considerably. The amount of hospital bills paid ranged from 22 per cent to 95 per cent of the total amount of the bills, and the amount left unpaid ranged from less than 6 per cent of the total amount of the bills to as high as 78 per cent. The amount of unpaid bills ranged from less than $25 to more than $500.

DRAIN ON HOSPITAL RESOURCES

In essence, accident patients who do not pay for the hospital care received are charity patients, and the hospitals are penalized to the extent to which these patients are not paying for their care. It hardly needs to be pointed out that unpaid hospital bills in highway accident cases in most instances are a definite drain on the financial resources of the hospital and that hospital deficits arising out of the care of highway accident cases eventually must be borne by the local community.

A question that needs to be given serious consideration is: to what extent should the local community bear the financial burden arising out of the care of highway accidents that happen to occur in the hospital's locality? Figures recently collected seem to show that the financial problems incident to the care of highway accident patients in local general hospitals are only partially a problem for the local community to meet. This survey revealed that a little more than one-half of the total of the 1,781 highway patients that were cared for in New Jersey hospitals came from the hospital city or town. About 38 per cent came from New Jersey, outside the hospital community, while more than 8 per cent came from 12 other states. It should be noted moreover that in the hospitals located along the main arteries of automobile travel, hospital cases from out of the state number more than one-half of the total highway accident cases handled.

PROSPECTS FOR RELIEF

What are the prospects for relief to the hospitals from the financial burden imposed by the non-payment of bills rendered to highway accident cases? Some hope for a reduction in the number of hospital cases may be held out through safety education campaigns, through the adoption of adequate safety regulations, and through the installation of effective safety devices.

The figures on the number of motor vehicle accidents are not encouraging, however, since the number of such accidents apparently is increasing everywhere. New York State, for example, reports 93,689 accidents in 1929 with 114,807 persons injured. In one year (comparing the 1929 figures with those of 1928) the number of accidents increased over 14 per cent and the number of persons injured, almost 16 per cent.

Moreover, the owners of motor vehicles are constantly increasing in number. The registration of motor vehicles in the United States reached the twenty six and one-half million mark in 1929, an increase of more than two million registrations over those of 1928. An increasing number of people are using buses in the United States. More than two billion passengers were carried on 92,500 motor buses in 1929.

The ease with which motor vehicles may be acquired nowadays, even by those of comparatively moderate means, signifies not only that ever greater numbers will be driving automobiles but that the number which might be classed as financially irresponsible, from the standpoint of compensation in highway accident cases, will be increasingly augmented. In this connection the following figures may have some significance:

During 1929, 423 finance companies in this country reported having financed the acquisition of 3,478,373 cars valued at $1,603,328,170. Almost 46 per cent of new cars and about 58 per cent of used cars were sold on the installment plan in the United States in 1929.

Insurance protection for hospitals. As the adjustment of industrial accident cases at first was a purely individual matter, later to come under complete state regulations in most of the states, so the adjustment of highway accident cases is beginning to receive legal cognizance in a number of states by the inclusion of limited or partial compulsory automobile liability insurance features in their motor vehicle laws. States having such features include Connecticut, Maine, Vermont, New Hampshire, New York, West Virginia, and North Dakota.

Massachusetts is the only state having general, compulsory automobile liability insurance. Its law provides that before a car is registered, its owner hold either a motor vehicle liability policy or bond protecting him to the amount of $5,000 for the injury of one individual and $10,000 for the injury of more than one individual in a single accident, or that he deposit with the Department of Public Works cash or satisfactory security to the amount of $5,000.

The subject of insurance needs arising out of highway accident cases is being studied by a number of states. The Virginia general assembly has been most explicit in the direction such studies should take: to determine the advisability of passing laws for compulsory compensation insurance for all automobiles; to work out a schedule of awards of compensation for injuries and to consider the method by which the funds necessary for the operation of such insurance should be administered; to make comparisons of the cost of compulsory compensation insurance by the state with compulsory compensation insurance by insurance companies and compulsory liability insurance by insurance companies.

Automobile insurance not a financial guarantee to hospital. The fact that a state may have an automobile accident liability insurance law in itself offers no guarantee to the general hospitals that they will be compensated automatically for services rendered in highway accident cases. The existing laws contain no mandatory features that the hospital must be reimbursed for the cost of hospital care in automobile accident cases.

It is significant to note, however, that when the person who is responsible for the accident is insured, the hospital is much more likely to be reimbursed for the care given to hospital patients resulting from the accident. Three New Jersey general hospitals which have cared for more than 300 highway accident cases found that when the person responsible for the accident was insured, the hospitals have been able to recover 70 per cent of the total amount of the hospital bills rendered, from the patients. On the other hand, when the person responsible for the accident was not insured, the hospitals were reimbursed only to the extent of a little over 30 per cent of the total amount of the hospital bills, the remainder being considered practically a total loss.

"Safety Responsibility" Laws. Recently, a number of states passed so-called "safety responsibility" laws framed with a view of curbing reckless drivers, compelling them to bear the cost of their recklessness and suspending the licenses of those who fail to meet the damages found against them. The criticism leveled against these "safety responsibility" laws is that some of their most stringent features do not become operative until after a man has shown his disregard for public safety by the criminal operation of his automobile, and that they offer no absolute guarantee of compensation for the victim of an accident.

The Safety Responsibility Committee of the American Automobile Association has drawn up a model "Act to Eliminate the Reckless and Irresponsible Driver from the Highways" through which it is hoped to remedy some of the deficiencies in the existing statutes and point the way to states contemplating the enactment of "safety responsibility" laws.

Hospitals given right of lien. Several states have attempted to meet the situation faced by the hospital through the care of highway accident cases by giving the hospital the right of lien. "Hospital lien" bills were recently considered by the legislatures of California, Maryland, New Jersey, New York, Pennsylvania and Washington.

The hospital lien bill enacted by the 1930 New Jersey legislature provides that "Every charitable association, corporation or other institution maintaining a hospital in the State of New Jersey supported in whole or in part by private charity, shall have a lien upon any and all rights of action, suits, claims, counterclaims or demands of any person admitted to any such hospital and receiving treatment, care, and maintenance therein, on account of any personal injuries received in any accident as the result of the negligence of any other person or corporation which any such injured person may or shall have, assert or maintain against any such other person or corporation for damages on account of such injuries, for the amount of the reasonable charges of such hospital for such treatment, care, and maintenance of such injured person at ward rates in such hospital up to the date of payment of such damages."

FIFTY ADMINISTRATORS EXPRESS THEIR OPINIONS

An inquiry was directed to more than 50 administrators of general hospitals in New Jersey asking them to analyze their experiences with highway accident cases and to give their recommendations for dealing with the hospital problems arising out of the care of highway accident cases. The answers may be summed up as follows:

1. The majority of the hospitals expressed themselves as having to give an undue amount of free service for highway and other non-industrial accident cases not properly belonging to the hospital district.

2. All of the hospitals say it is exceedingly difficult if not entirely impossible to collect a large percentage of the bills for highway accident cases. The insurance companies usually pay the injured person who, in turn, leaves the hospital without paying his bill.

3. The majority of hospitals feel that the person responsible for the accident should assume

the hospital bill and that if he does not some governmental authority should pay. Surprisingly few hospitals place any responsibility on the patient who is receiving the treatment. The town or county in which the accident occurs, the town or county of the residence of the injured, and the state for non-residents of the county and of the state are suggested as agencies to assume the financial responsibility for highway accident cases.

4. Compulsory automobile insurance is recommended by nearly every hospital, with the liability insurance to be strictly under state control and each license to carry with it a liability policy. An organization is suggested similar to the Workmen's Compensation Bureau for the adjudication of claims and the division of available funds to claimants, including the injured person, the hospital, the doctor or any others who have served to rehabilitate him.

PHYSICAL THERAPY IN FRACTURES OF BOTH BONES OF THE LEG[1]

JOHN S. COULTER, M.D., F.A.C.S., CHICAGO
Assistant Professor of Physical Therapy, Northwestern University

THE final aim of the treatment of fractures of both bones of the leg is the restoration of the functions of the injured leg. The use of physical agents as an adjunct in this treatment is not only valuable, but essential. Many of the ideas prevalent as to their methods of use are very vague, and many surgeons have not made a close enough study of the subject to give definite directions for their use. Therefore, the greatest success in the restoration of function following fractures depends on close co-operation between the surgical and the physical therapy departments.

In physical therapy the agents of the greatest use are heat, light, water, massage, and exercise. Of all therapeutic adjuncts these are the simplest, the most flexible, the most easily obtainable, and the cheapest. These agents should be used on definite written prescriptions. Records of progress should be kept. Signs of recovery should be pointed out to the patient, thus rousing in him an interest in his own progress. Where improvement is not being made, the patient should not be encouraged in a treatment habit.

Physical therapy has been criticized by insurance companies and employers, for they say it has increased the cost of treatment in traumatic injuries without producing results. This criticism is correct in many cases, but not where it has been correctly used. It is unjustifiable to charge for physical therapy in which only some form of heat has been used for a short period daily, for this is not the correct use of physical therapy. The aim of this short paper is not to discuss the actual technique of the use of physical agents, but to urge the necessity of them for longer periods daily in the treatment of fractures.

The most common mistake in the use of physical therapy in the after-care of fractures has been that the patient is treated once daily, at best, and given the impression that some piece of apparatus is going to help him regain function. Neither that machine nor the surgeon can give the patient the best functional results unless the co-operation of the patient is enlisted so that he will carry out definitely prescribed directions and use these physical agents for long periods daily.

The principles of treatment of these fractures may be reduced to the formula: early reduction, proper retention, early function.

Physical therapy is mainly concerned in the early restoration of function but it must not be expected to overcome the disabilities produced by neglect of the other two principles of treatment.

HEAT

Our usual physical therapy prescription is heat, massage, and exercise. We have a scientific basis for the use of heat early in injuries, especially in fractures, and it should be used from the first day. In a recently published article on his investigations in the repair of fractures, Murray says:

"Fractures always heal, unless there is a mechanical bar to tissue growth. The healing is accomplished as with wounds elsewhere, by the growth of granulation tissue. . . .

"The source of calcium for this calcification is dead and autolyzed bone at the site of fracture and not the blood stream. Bone as a calcium source can be experimentally replaced by both inorganic and organic salts of calcium. Bone and soft part circulation are of prime importance in the process of calcification of fracture healing and should, therefore, be prime objects of attention

[1]Presented in the Conference on Traumatic Surgery, before the Clinical Congress of the American College of Surgeons, Philadelphia, October 13–17, 1930.

early in the bone healing process. The time to use elevation, heat, massage, diathermy, and active exercise is at that time, if possible; it is much more important than later in the course."

Every surgeon has numerous uses for the therapeutic application of external heat and should have in his possession several appliances giving radiant heat. These appliances may be used at the hospital or in the patient's home for only a small extra charge. In our dispensary, hospital, and home cases we have definite mimeographed directions for their use and for the use of other forms of heat, such as contrast baths. It is known that the use of heat increases the local circulation of the part and that good local circulation is essential for repair of fractured bones. Therefore this heat should be applied for hour intervals at least 3 times daily. Surely the local circulation needs to be increased more than 30 minutes daily. Heat appliances are reasonably priced, electricity is cheap, and none of our patients has objected to the small charge necessary to rent the requisite appliances.

MASSAGE

Here is another physical agent that may often be used in the treatment of fractures without adding to the cost of this treatment. The surgeon has not the time to give massage, but he should have the time to prescribe it and see that it is given properly. In a fracture of both bones of the leg, in addition to the bone injury, there are torn ligaments, lacerated muscles, tenosynovitis, and a traumatic arthritis. There is hæmorrhage from the torn vessels. The above conditions interfere with the circulation, but often we have a swelling above and below the injured area which the local conditions could not cause. This is due to a reflex disturbance of the vasomechanism from an injury to the nerves.

In fractures of both bones of the leg treated in a Thomas splint with skeletal traction, the surgeon should take the time to instruct the nurse or, if necessary, a member of the patient's family to give superficial stroking massage. This consists of the passage of the hand over the patient's skin above and below the fracture, where the parts are exposed, with a slow, gentle, and rhythmical movement. This form of massage aims only for a reflex effect on the circulation. Therefore the direction of the movement is unimportant, provided it is always in the same direction. This massage movement is one that should be started early and it cannot cause trouble because the movement must be gentle. It should be remembered that in cases of fracture of both bones of the leg in a circular cast, it may be an advantage to split this cast into halves, removing the upper half several times daily to allow the application of radiant heat and superficial stroking massage. Here again in our clinic we use definite written instructions for massage movements. It is realized that massage is best given by a well trained technician under a physician's direction, but we believe, in addition to this and without a technician if necessary, much can be accomplished by the surgeon instructing some member of the family or the nurse in a simple massage movement.

The other movements of massage are heavier and are aimed to influence the circulation directly. These are started at a later period and must be performed only by experienced and trained hands, for unless that person is extraordinarily observant and careful, there will be a recurrence of the deformity. Massage, if properly applied, increases the local circulation, but if applied too heavily may damage the delicate arterioles of the muscles and thus have the opposite effect.

The first 7 to 10 days following the accident are the most important for early bone regeneration. It has been found that ossification begins during this period. Injured tissue cannot be healed by massage, but we can assist in restoring the circulation on which the repair depends. The time to commence massage requires the judgment of experience, but it should be in the first week following the injury. Suggestions regarding this and the technique have been considered in another article.

Cotton says: "In fact it is but rarely that a case of fracture leaves my care without having had more or less massage, and year by year I call for it more and more. Those who are to treat fractures should know enough to control this work."

EXERCISE

Therapeutic exercise is the scientific supervision of bodily movements with or without apparatus for the distinct purpose of restoring normal functions to diseased or injured tissues. There is a maneuver which can be practiced early in the treatment of these fractures, which is highly beneficial. This is termed static exercise and can be practiced by the patient while his leg is in the splint or cast. It is the alternate contraction and relaxation of the quadriceps without movement of the knee and of the tibialis anticus and extensors without movement of the foot or toes. This type of exercise may be difficult for the patient to learn. It should be practiced under the watchful eye of the operator until the patient has accomplished it. Static exercise is used in the early stages of acute traumatic injury or when it is impossible to obtain joint movement in chronic

cases. Great benefit is derived by its use in maintaining muscle tone and strength.

Relaxed movement or passive exercise is that form of bodily movement which is carried through by the operator without assistance or resistance by the patient. In fractures of both bones of the leg mobilization of the joints should begin early, but arrangements must be made to prevent movements from throwing strain on the seat of the fractures. This may be done by using the posterior half of the cast as a support and moving the ankle in dorsal flexion and the foot in inversion only. In a Thomas splint the fractures should be supported manually. The occurrence of a muscle spasm is a danger signal. If such a spasm occurs the operator should stop immediately. It should be remembered that a slight tightening of the muscles precedes pain. Therefore, to secure the best results all movements should be well within the limit at which pain occurs. Passive exercise of muscles prepares them for active movement.

Active exercise is that form of bodily movement which is carried through by the patient with or without the personal supervision of the technician. In fractures of both bones of the leg there has been a lengthy period of inaction which impairs the power of muscle co-ordination. All movement is the result of the contraction of one group of muscle combined with the relaxation of its antagonistic muscles. This is especially true in walking, and the efficient working of one muscle is dependent on the similar capacity in many others. Therefore, in these fractures it is easy to realize that marked weakness of one group of muscles will interfere greatly with proper co-ordination in walking after this injury.

Too often a patient is allowed, after weeks in a cast, to start weight bearing on his injured leg without previous exercise and even without the normal support afforded his foot by his shoe. This patient gets up with crutches, his foot usually in a slipper and attempts to walk, his hip rotated externally, his knee stiff, and his foot everted. This is not a natural position for walking and results in still further muscle strain and loss of co-ordination.

In our treatment of these cases we realize that all such patients need re-education in walking. Again this may be made a simple process not adding to the cost of the treatment if the active co-operation of the patient is enlisted. The surgeon should have definite written directions for re-education in walking, to be used in the cases in which it is necessary to watch the cost of the treatment. These movements should be started before weight bearing is allowed. These directions are mimeographed and left with the patient after the surgeon gives instructions in the kind of exercises, the number of times for each, and the number of times in a day the series should be performed. The patient should be impressed with the importance of insuring the return of co-ordination. He should be told that, while heat, diathermy, massage, and electrical muscle stimulation increase the local circulation and at certain times are of great value, nothing will increase the strength of his muscles and the return of co-ordination but the proper use of these muscles. He should also be cautioned against fatigue.

Some directions for re-education in walking are:

1. Sitting on side of bed, swing legs to and fro alternately.

2. Same as *1*, except on every fourth swing hold leg out straight for a count of three.

3. Same as *1*, now add ankle movement. When leg is straight bring foot up and when bending knee push foot down.

4. Sitting on chair, raise toes alternately from floor.

5. Same as *4*, except raise right toes with left heel and left toes with right heel.

6. Stand on sound leg between two chairs and swing the injured leg to and fro. See that this is like the natural movement of walking (leg forward, knee straight, and ankle dorsally flexed).

7. While sitting, at all times rest with legs crossed and feet resting on outer borders. In this position claw with toes.

8. Same position as *7*, rise from chair, supporting most of weight on hands. Increase height of rise and reduce weight on hands.

9. Standing, supported by a chair in front, with feet side by side and weight on outer borders, bend knees.

10. Stand between two chairs as in *6*, except that when injured leg is forward, the heel is placed on the floor. The body weight is then thrown forward by raising the heel of the sound leg and bringing the toes of the injured leg down. Rock to and fro in this position. At first all weight is supported by arms and sound leg. Increase by removing chair support.

All weight bearing exercises should be performed in proper shoes with felt pad arch supports in position. In addition to these exercises others are given from the mimeographed sheets of foot and knee exercises, and we shall be glad to furnish them to those interested. To avoid monotony and to increase the patient's interest we use another form of therapy namely—occupational therapy.

OCCUPATIONAL THERAPY

The therapy of a curative workshop is based on the fact that the best type of remedial exercise is that which requires a series of specific voluntary movements, initiated by the patient, forming an integral part of a more complex series of co-ordinated movements, with a purposive nature to secure end-products and thus a direct incentive for sustained effort. It is on this theory that we introduce ordinary occupation and play.

The ordinary physical therapy given to a patient, at the most, lasts only an hour and the exercises have certain definite limitations. The human body is more than a machine and the formal repetition of a movement either with or without an apparatus is not of maximum therapeutic value in increasing the amount of movement in a stiff joint or as an integral part of a larger co-ordinated movement. There is no psychological stimulant for personal incentive or sustained effort.

Success in the treatment of injuries can be increased by the combination of physical therapy to prepare the part with the use of heat, massage, etc., for the activity of occupational therapy. One without the other is not as successful as the combined.

Occupational therapy may be obtained in a curative workshop where there is equipment such as foot power looms and bicycle saws for specific exercises for the leg, or it may be applied at home under the direction of the physician and with the help of the family. This latter choice is inexpensive and very effective if the patient is willing to co-operate.

The man who is "laid-up" at home with a fracture of both bones of the leg can refinish furniture. This involves constant squatting and raising as the rungs of a chair, etc., are sand-papered and finished. This bending and straightening of the leg offers exercise while the patient is thinking of his job. He is conscious of the exercise but inspired by his work. Planting a garden or caring for it, with short tools, involves the flexion and extension of the hip, knee, and ankle. A prolonged cramped position should be avoided.

Games may also be devised for this purpose. The acts of kicking, running slowly, and skipping can be directed so as to exercise any group of leg muscles. In games the element of competition with either an opponent or the record of a previous day gives incentive for the actual exercise.

If the patient is working at home, he and his family will take an interest in this form of exercise and during the events of the day will discover other normal tasks which will provide opportunity for the repetition of an exact motion. This is an important factor for it does away with the more or less unconscious effort to save the affected part. Again, definite directions will impress the patient with the surgeon's interest and repay for the time taken in the functional restoration shown by the patient.

CONCLUSIONS

Physical therapy is not only valuable but essential in the treatment of fractures of both bones of the leg. It contributes greatly to the shortening of the period of disability and to the improvement of functional results. The use of the simple physical agents on definite written prescriptions over longer periods daily will definitely improve the results of functional restoration after fractures.

INTERNAL DERANGEMENT OF THE KNEE[1]

WILLIS C. CAMPBELL, M.D., F.A.C.S., MEMPHIS, TENNESSEE

TRAUMATIC lesions of the external cartilage of the knee have not received due consideration in the past and are sometimes overlooked at examination. They occur less often than do lesions of the internal cartilage, which probably accounts for the greater interest manifested in internal cartilage injuries.

The common traumatic injuries of the external semilunar cartilage are as follows: (1) derangements, (2) hypertrophy, and (3) cysts.

Derangements or fractures and dislocations of the external cartilage, as we have said, are not so common as those of the internal cartilage, the ratio being 1 to 15. In our series of 108 derangements of the semilunar cartilage there were 19 of the external and 89 of the internal. The greater frequency of derangements of the internal cartilage is due first, to the fact that the mechanism producing such injuries is by far more frequent than that which causes similar lesions of the inner cartilage; second, more severe trauma is required to injure the external cartilage; and third, there is a difference in the anatomical relations of the two cartilages which may be enumerated as follows:

1. The internal cartilage is in close relation and loosely attached to the weakest or anterior portion of the internal ligament and is firmly attached to the posterior or stronger portion of the ligament. This obviously makes a weak point in the mechanical construction of the semilunar cartilage. The external cartilage, not being attached to the external lateral ligament, is not subject to injury from the same types of trauma.

2. As the vastus internus and semimembranosus tendons are partially inserted into the internal lateral ligament, the internal cartilage may be directly injured by muscular contraction.

3. The internal condyle of the femur rotates upon the internal cartilage and when laxity or displacement is present may forcibly pull or roll the cartilage out of position, while the external cartilage is fixed by the pivotal action on the external condyle.

4. The internal cartilage is larger, nearly semicircular in shape and does not conform to the articulation as well as the external cartilage does and is, therefore, more easily avulsed or fractured.

5. The internal cartilage bifurcates at the anterior extremity and is, therefore, more susceptible to longitudinal splitting.

6. The coronary ligaments of the external cartilages are longer than those of the internal, permitting greater play without rupture or severing.

Derangements of the cartilages are frequently observed in young athletes, but are by no means infrequent as an industrial problem. They may occur at any age but are extremely rare in old age. This is probably due to the evolutionary change in structure as age advances, as has recently been demonstrated.

The mechanism of derangement of the external cartilage is reverse to that required for derangement of the internal cartilage. The foot is usually fixed upon the ground, the femur is rotated out upon the tibia, and at the same time the knee is adducted. The same mechanism may also rupture or stretch the external lateral ligament and the posterior crucial ligament.

Lesions of both cartilages are fractures and dislocations but the description of those of the external cartilage is usually summarily dismissed as being similar to that of the internal. The more common lesions which I have observed in the external cartilage are as follows:

1. Separation of the posterior extremity and lateral attachment, the anterior extremity remaining attached.

2. "Bucket handle" fracture. This consists of a longitudinal or rather circumferential fracture as the external cartilage is circular, with displacement of the inner portion inward, which may impinge within the articulation. This does not resemble the handle of the modern bucket, but the handle of the old-fashioned leather bucket in common use in England about 30 years ago.

3. Total avulsion with separation from all attachments. After derangement, the cartilage is always folded upon itself and secondary injury will occur unless the displacement is reduced or the cartilage excised. In this group may be found all varieties of fractures. At times the cartilage may be ground to pieces by the joint action and act as loose bodies. For reasons already stated, primary fractures here do not occur as often as primary fractures of the internal cartilage.

The symptoms of derangement of the external cartilage often are described simply by stating that they are similar to those of the internal cartilage, only occurring on the external side, whereas, as a matter of fact, there is some difference. The chief symptom—great pain with locking

[1]Presented in the Conference on Traumatic Surgery, before the Clinical Congress of American College of Surgeons, Philadelphia, October 13-17, 1930.

and blocking of the joint in flexion, usually at an angle of about 150 to 120 degrees—is due to the impingement of the cartilage between the external condyle of the femur and the external tuberosity of the tibia. There is usually greater flexion in derangement of the external cartilage than in displacement of the internal. The joint is not locked, as commonly described, but is blocked. Extension is usually limited while a full flexion is free. Pain is excessive, especially at the first occurrence of the derangement, but is usually more vague. It may be referred to the posterior, middle, and anterior region of the external half of the joint and at times is indefinite. This attack is followed by effusion into the joint. There is often tenderness over the attachment of the external lateral ligament on the external aspect of the external condyle of the femur, and over the head of the fibula, also on the external aspect of the articular surface of the external tuberosity of the tibia, and often in the popliteal space about the attachment of the posterior crucial ligament. These points of tenderness may remain indefinitely, being exacerbated with each recurrent attack, or they may entirely disappear during the interim. If the external ligament is impaired, increased motion to the leg on the inner aspect will be present when the knee is extended. In a normal knee joint no motion in this direction is possible. However, in certain individuals with congenital relaxation of joints there is often lateral play in the knee joint. This condition can be determined by a comparison with the opposite knee. Any defect in this ligament must be noted, as the prognosis will be materially affected. Subsequent attacks may complicate by causing further damage to the cartilage and in many instances may cause a low grade progressive arthritis, invading the structures of the entire joint. In some instances the recurrent attacks become less severe, which the patient may learn to endure with slight discomfort. In some, the joint reaction with each attack is more pronounced.

The treatment is conservative in the acute stage or after the first attack, and radical should there be repeated derangements. If the proper measures can be instituted at the time of the initial lesion a perfect cure may be expected in a large majority of cases. This consists of first reduction. Anæsthesia will be required unless full co-operation of the patient is secured. The patient reclines upon a table. The knee is flexed as far as possible, and the hip is flexed upon the abdomen. The leg is rocked and rotated from side to side and adducted as much as possible. Suddenly with the muscles completely relaxed the knee is extended and the leg is rotated outward by grasping the foot. If there is the slightest muscular resistance the procedure is not effective. In reduction of the internal cartilage the leg is rotated inward as extension is effected, otherwise the procedure is about the same. Where reduction is accomplished there will be elicited a definite click or snap and the knee can be extended without stress. Also, if there has been no anæsthesia, the patient experiences great relief, and the knee feels "right" again. After reduction the knee should be held in complete extension for a period of 30 days by means of a cast or splint. Weight bearing should be enforced. At the end of 30 days active motion is instituted, but a steel cage knee brace should be applied which permits extension and flexion but no rotation. This should be worn for a period of about 3 months. Physiotherapy is not essential except in the more severe injuries and in those past the age of 35. However, such measures do add to the comfort of the patient and possibly, to some extent, hasten convalescence. In those in which there are repeated attacks, operative measures are indicated, the results of which depend upon three factors: (1) complications by associated derangements other than that of the cartilage, (2) the efficacy of the operation, (3) the extent of organic changes within the joint that have been induced by constant irritation of a displaced cartilage.

Spontaneous recovery is possible if the cartilage adheres to some recess of the joint, as the intercondylar notch, and is not capable of further interfering with function, or possibly the cartilage may be ground to pieces between the articular surface and in time disappear. However, the equation in surgery is always not that which is possible, but that which is more probable. The chances of maintaining the integrity of the part is undoubtedly far better by excision before organic changes have occurred.

The operation must be carried out, as is well known, under the most rigid aseptic technique, and may be described as follows:

A straight incision is made about one inch to the outer aspect of the patella parallel with the patellar tendon. This incision begins on a level with the middle of the patella and extends down to a point just below the external tuberosity of the tibia and is continued through the soft structures to the joint in the same manner as in the approach to the internal cartilage. If more room is required the lower end of the incision may be carried backward and outward for one or two

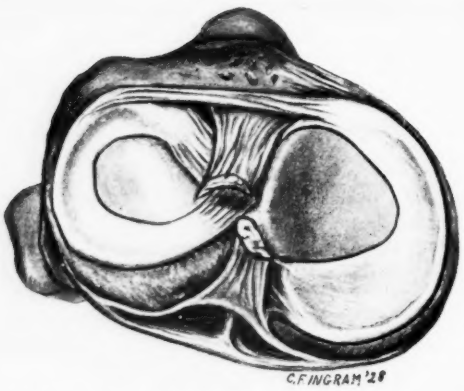


Fig. 1. Drawing of interior of knee joint showing superior surface of tibia, semilunar cartilages, and crucial ligaments. Note the transverse ligaments anteriorly connecting the internal and external semilunar cartilages.

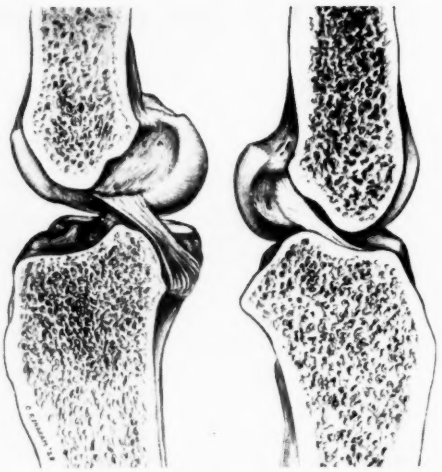


Fig. 2. left. Sagittal section of knee showing attachments of posterior crucial ligaments.

Fig. 3. Sagittal section of knee showing attachment of anterior crucial ligament.

inches, care being taken not to injure the external lateral ligament. However, the straight incision is usually sufficient, as the external cartilage is often avulsed and can be easily removed.

In those in which there are symptoms suggestive of lesions in the posterior portion of the cartilage, a posterior incision should also be made just anterior to the head of the fibula, care being used not to injure the external popliteal nerve. This will give access to the posterior compartment and permit severing the posterior extremity of the cartilage, after which the entire cartilage may be removed through the anterior incision.

The entire joint should be most carefully inspected for associated lesions which may cause symptoms of derangement. Special attention must be given to the posterior crucial and the external lateral ligaments. If these structures are impaired a more complicated procedure is required to repair efficiently one or both. It is not infrequent that other lesions complicate or are caused by persistent derangement of the cartilage.

Hypertrophy of the extended semilunar is of very rare occurrence. This condition may be due to repeated trauma or may be a congenital anomaly. The exact etiology is unknown. The symptoms complained of are a very loud snap or click, with more or less pain and disability. In one case the noise made was so loud that any appearance in public was extremely embarrassing. In many instances the symptoms will either disappear or will not be so apparent to the patient, while in others there will be no abatement or they may become progressively more severe. In 4 cases the author has operated upon, the appearance was the same as described for derangements of the external semilunar cartilage. The extended cartilage was hypertrophied to about three times that of a normal cartilage. The snap was not so pronounced under anæsthesia but was thought to be in the posterior portion of the joint. Treatment is often not indicated, as symptoms are not of sufficient severity. In those in which there is increasing disability and a very loud snap, complete excision of the entire cartilage is indicated.

Cysts of the semilunar cartilage are probably more frequent than is generally known. The external cartilage is by far more often affected, the internal very rarely; approximately 50 cases have been reported. The author and his associate, Dr. Joseph I. Mitchell, reported 10 cases, since which time 4 more have been observed, making a total of 14, of which there were 13 external and 1 internal. In one case there was a cyst well below the joint line which was removed twice, recurred and was later found to be a cyst of the cartilage.

Trauma has been assumed as the prime etiological factor; however, three theories have been advanced: (1) degenerative, (2) traumatic, and (3) congenital.

1. *Degenerative theory.* The earlier German observers were of the opinion that the cysts were due to softening and colloidal degeneration of the periarticular tendinous or periosteal tissues about the knee, owing to deficient nutrition following

Fig. 4. Drawing showing cyst of external semilunar cartilage.

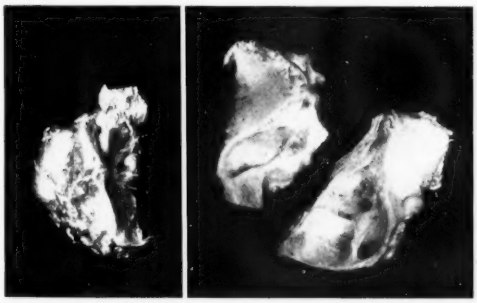


Fig. 5, left. Photograph of specimen of cyst of semilunar cartilage, showing location of cyst in middle third of cartilage.

Fig. 6. Photograph of cross section of cyst and cartilage showing multiple spaces separated by thin walled septa.

trauma. Phemister agrees with this view and points out that the pathological findings are identical with those of the cystic swelling or ganglions which occur in various connective tissues, especially on the back of the wrist. Ledderhose attributed the pseudocystic degeneration to a primary, obliterative endarteritis of traumatic origin. This endarteritis is not constantly present, and it is more likely, according to Phemister, that the vascular alterations are simply a part of the degenerative process and not the initial change. Jean concludes that the lesion is a pseudocyst caused by a peculiar type of degeneration of the fibrocartilage, from unknown cause, perhaps favored by the avascularity of the tissue. Allison and O'Connor believe that the cyst represents the end-result of a degenerative process caused by interference with the blood supply of the cartilage in the affected region, the exciting cause of which is a non-lacerating injury. Kleinberg states that the cyst is due to some form of injury or to disturbance of metabolism of the cartilage cells without injury, following which defects appear in the meniscus. As pointed out by Jean, there is no support for the theory of bacterial infection. Culture of the contents of the cysts and of fragments of the cartilage have been negative and there are no symptoms of inflammation. The Wassermann test on the blood has been negative in all cases.

2. *Traumatic theory.* Practically all observers agree that trauma plays an important part in the causation although only about one-half of the reported cases give a history of definite injury. Fisher suggests that the trauma may be either from without or may be indirect through strain of the tendon of the popliteus muscle, as this muscle lies in close approximation to the middle portion of the external semilunar cartilage at the one place at which the outer margin of the cartilage is covered by synovial membrane. Fisher also states that the cyst is a ganglion developed between the synovial membrane and the outer surface of the cartilage, although he admits the cyst may invade the cartilage. Zadek believes that the cysts are due to ingrowth of the synovia following tears of the outer portion of the cartilage. The chief argument against the traumatic origin is the fact that the cysts usually occur in the external cartilage while the internal cartilage is much more frequently traumatized. Also, it must be remembered that the tendency exists to attribute all joint disabilities to remote injuries.

3. *Congenital theory.* Ollerenshaw has suggested that the cysts are developmental in origin due to fetal rests of the endothelial cells in the cartilage which, when stimulated by trauma, are rapidly distended. This hypothesis, which is analogous to the inclusion theory proposed by Cohnheim as the specific cause of neoplasms, is not generally acceptable.

PATHOLOGY

The gross appearance of the cysts in the cartilages which have been excised has been identical. The cysts were located in the peripheral portion of the middle third of the meniscus, definitely within and a part of the cartilage, their

outer walls being formed by a thin shell of expended fibrocartilage. On the interior the cysts were divided by fibrous septa into several communicating cavities of varying size, the larger loculi generally lying toward the periphery of the tumor and the smaller ones centrally. The large spaces appeared to be formed by coalescences of the smaller cavities. The inner surfaces of the walls were smooth and glistening and the mucoid substance, thick and transparent, sometimes slightly tinged with red or yellow, resembled the colloid material in ganglions.

The microscopic appearance of the cysts has been a subject of debate. Ollerenshaw was the first to describe a definite endothelial membrane lining the cysts. Other authorities state that no lining membrane is present. Kleinberg found the larger cysts lined by a layer of large, flat cells resembling endothelial cells which he believed had probably arisen from lymph vessels. Zadek described the smaller cysts as lined by a membrane consisting of synovia-like endothelium. On the other hand, Phemister could find no evidence of an endothelial lining, nor could Latulle or Guy who examined the specimens reported by Jean; nor Walbach, who examined the cases reported by Allison and O'Connor.

Our impression is that the cysts arise from the splitting of the connective tissue fibers along parallel planes and that no definite lining membrane is present. A careful microscopic study of one of the cases was made, and the report was as follows:

"A section cut transversely through the specimen of cartilage consists largely of fibrocartilage with greatly thickened perichondrium. In the fibrocartilage there are many small linear spaces which seem to have been formed by cleavage along parallel surfaces. None of the cysts is spheric. The perichondrium is thickened and contains numerous thick walled blood vessels and dilated lymph spaces. In the zone near the perichondrium there are irregular clumps of pale mononuclear and polynuclear cells. In a few places the impression is gained from the regularity of position of the low, elongated nuclei that there is a lining membrane, but there are other sites where the nuclei are not so regularly spaced and still many other sites where nuclei are absent. The thickened blood vessels and infiltrating, wandering cells indicate chronic inflammation. The relation of the cyst-like spaces and the dilated lymph channels is uncertain."

SYMPTOMS

The duration of the symptoms varies from a few weeks to several years. One case was observed one week following trauma, the symptoms having appeared immediately. Phemister states that the cysts seem to attain their maximum size within a few weeks, after which they remain stationary, and that there is no instance of spontaneous disappearance. This is probably inaccurate. In a case previously reported the tumor subsided after a short duration, although the other symptoms persisted, and in another case the symptoms were recurrent. In still another case the tumor disappeared and the pain was entirely relieved by aspiration of the colloid contents of the cyst.

The symptoms are similar to those of other derangements of the knee joint, but without locking or snapping. Pain, limp, and interference with joint motion, associated with a visible and palpable tumor in the region of the cartilage, are characteristic manifestations. The pain may or may not be constant and is aggravated by functional use. The pain is also aggravated by rotation of the leg and is worse on full extension and flexion of the knee, the most comfortable position being at about 70 degrees or 80 degrees of flexion. The tumor is firm, resistant to pressure, and tender. The size of the tumor varies but the location is fixed and unchangeable. It is always immediately overlying the cartilage on a level with the joint line and is firmly fixed to the tibia and moves with the tibia in all movements of the knee joint.

The roentgenogram is usually negative, although a shadow in the soft tissues in the affected region may be visible, and, rarely, there may be a slight flattening of the adjacent portions of the femoral and tibial condyles.

TREATMENT

The treatment is surgical. Excision of the entire cartilage is recommended, as Riedel and Schmidt have reported the recurrence of the tumor when the cyst alone was removed. The functional result depends upon the damage to the joint structures by the mechanical pressure of the tumor.

THE TREATMENT OF FRACTURES BY SKELETAL TRACTION[1]

SAMUEL R. CUNNINGHAM, M.D., F.A.C.S., Oklahoma City, Oklahoma
Professor of Orthopedic Surgery, University of Oklahoma

IN discussing a practical method for the treatment of fractures of long bones, I shall try to demonstrate the peculiar adaptability of skeletal traction of fractures in which no other form of extension can be used: namely, fractures with concomitant mutilation or burn of the soft parts, thus making it impossible to use casts or skin traction.

Recently, I was asked "How does your committee justify so much time and space to fractures?" Now, there could be several very pertinent answers to that question. One could say that it is because certain types of fractures have not been well treated. There has been too much useless and too much complicated apparatus used, and possibly some have resorted too much to open surgery.

There has been a rapid increase in the number of fractures, and at the same time a great change has come in the severity of fractures. The public also is demanding better treatment and better results than have heretofore been afforded. Thirty years ago in a city of 200,000 population we did not see as many fractures from all causes as we now see, in a city of similar size, resulting directly or indirectly from motor cars. We have observed, also, that motor cars, modern heavy construction, and oil field work cause much more severe and complicated fractures than we had to deal with a few years back.

Only a few years ago we seldom saw fractures of the spine, central fractures of the hip, or fracture dislocations of the ilium; now none of these fractures is uncommon.

The treatment of diphtheria and appendicitis and some other diseases, after going through a rather stormy period, is standardized and all doctors agree on their treatment. The treatment of simple or complicated fractures of long bones is not so generally well understood. For instance, certain individuals doing much fracture work have perfected mechanical devices which they use well and with which they secure good results. Others doing like work have perfected an open method and they, therefore, are apt to infer that only the unskilled surgeon uses mechanical methods.

I do open replacement of fragments under certain circumstances but I never leave in the wound any form of non-absorbable material—not once in the last 18 years have I done this.

At a meeting of railway surgeons within the last year, I heard good surgeons discuss the problem as follows:

"I am in favor of plaster of Paris as a fixation method of all fractures. The main defect with other forms of traction is that you must employ about 6 nurses to watch the frames, to keep the traction on, and to keep the weights adjusted. If

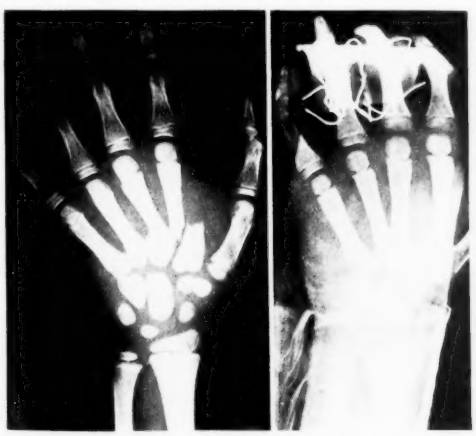


Fig. 1. Silver wire in flexor tendon at end of first, second, and third fingers. Wires fastened to strip of sheet aluminum.

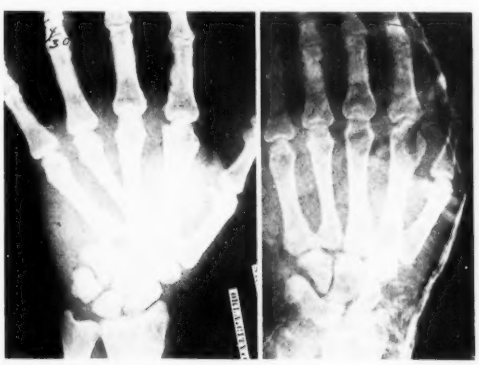


Fig. 2. Dislocation of second, third, fourth, and fifth metacarpal bones reduced by skeletal traction by use of towel clamps on distal end of these metacarpals.

[1] Presented in the Conference on Traumatic Surgery, before the Clinical Congress of the American College of Surgeons, Philadelphia, October 13–17, 1930.

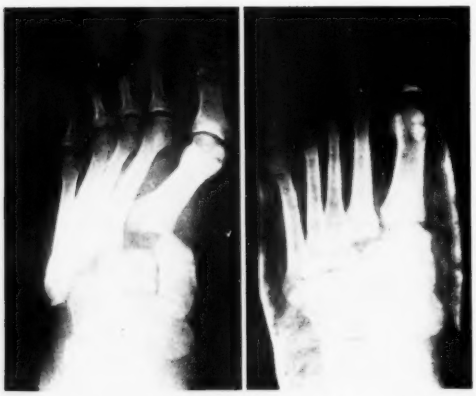


Fig. 3. Fracture dislocation of all metatarsals reduced by use of skeletal traction. Towel clamps for tongs.

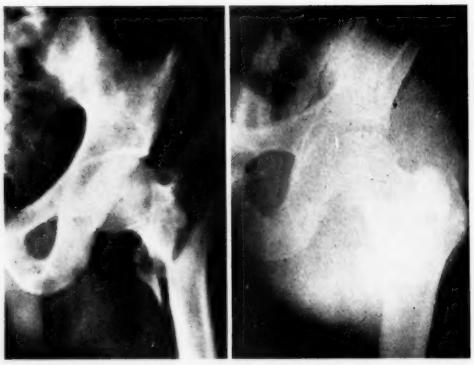


Fig. 4. Large woman 86 years old. Skeletal traction. Second picture made 30 months after first.

we put a case up in plaster of Paris we know exactly where we have our fracture and that it is going to stay right there." I am glad he can do that.

Another said: "In certain cases, open operation is absolutely in demand. Those who do open operations are impressed with the fact that a frequent cause of non-union is tissue interposed between the ends of the fragments, whether skeletal traction or plaster of Paris has been used, in which event open operation *must* be done, and, I can see no more danger in operating on the bone than in operating on the brain or operating in the abdominal cavity."

I can't agree with either one of them. I think they are both partly right. In the illustrations is demonstrated a method that we use in cases in which neither of their methods will yield satisfactory results.

Possibly it would be well to give here the percentages of certain types of acute fractures coming under our observation. Of 2,000 consecutive fractures of bones with shafts seen since January 1, 1928, 9 per cent were of the femur, 16 per cent of which were open fractures; 7 per cent were fractures of the humerus, 8 per cent of which were open fractures; 11.5 per cent were fractures of the radius, 8 per cent of which were open frac-

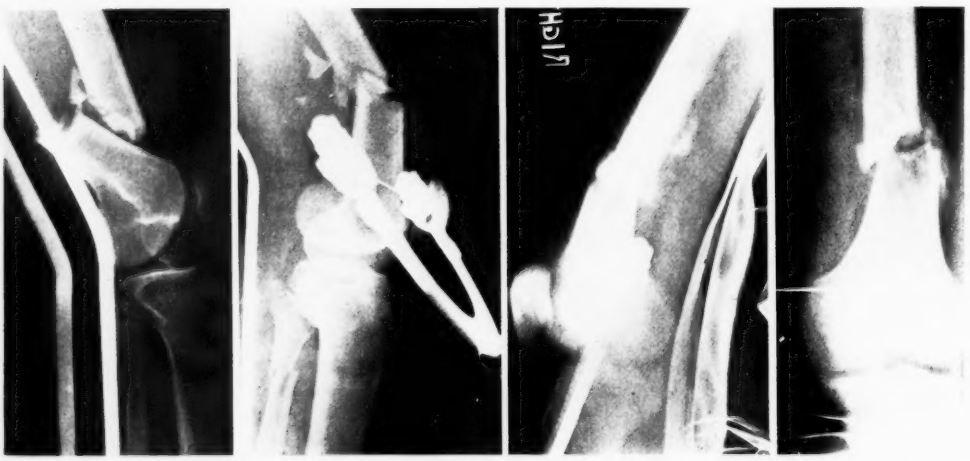


Fig. 5. Open comminuted fracture of femur and fibula. There was an extensive burn on the leg and ankle.

Fig. 6. Open comminuted fracture of femur. Tongs used above condyles. Patient now doing manual labor.

Fig. 7. Open comminuted fracture of humerus. Extension by pin through olecranon.

tures; 8.5 per cent were fractures of the phalanges of the fingers, 17 per cent of which were open fractures; 13 per cent were fractures of the metacarpals, 12 per cent of which were open fractures; and 11 per cent of all fractures were of the tibia, 14 per cent of which were open fractures.

In civil life 11.85 per cent of all fractures of bones with shafts are open fractures and many of them are best treated by skeletal traction.

The treatment of fractures by skeletal traction is not new. When he was dean and professor of surgery at the Medical College of Indiana 35 years ago, Dr. Joseph G. Marsee practiced and taught the use of skeletal traction in fractures of bones with a shaft.

In 1909 in a paper entitled, "Common Injuries of the Hand," I described practically the same method we now use for fractures of the metacarpals, metatarsals, and phalanges.

The various forms of extension tongs have been very effective and their use has not deserved the unfavorable criticism it has provoked.

I think we have found that the small steel wire drill offers many advantages over other methods of skeletal traction.

HEAD INJURIES OF MODERATE DEGREE[1]

A Review of One Hundred Cases, Including Fifty Ventricular Studies

GEORGE W. SWIFT, M.D., F.A.C.S., Seattle, Washington
Attending Neurologic Surgeon, Children's Orthopedic Hospital and King County Hospital

ONE-THIRD of all head injury cases seen in industrial surgery fall into a group of minor injuries. Perhaps there is some temporary loss of consciousness, but the patients are strong individuals and to them such a condition is of more or less trivial importance. As soon as the lacerations, if any, are healed, the patients are ready to resume their work. With these we have no further interest except to call attention to the fact that a strong, robust individual who receives a minor injury to his head, with no actual injury to the brain tissue, almost universally returns to work at the earliest possible moment.

On another side we have that group of patients which constitutes perhaps another third of the sum total, which receives a perfectly obvious total permanent disability, which is so recognized by the attending physician and the Department of Labor and Industries. This group of cases does not interest us in the present discussion.

The remaining third is that group of patients who, after a period of time, do not adjust themselves to their present condition. The factors involved in this failure of readjustment are, of course, first of all the injury itself. The more severe the injury without total disability, the more easy it is to observe physical findings which will correspond to the subjective symptoms. This, one might say, would constitute the upper margin of disability in this particular group, while the true malingerer, the man who feels that the state owes him a living and uses a head injury merely as a subterfuge, would be found at the other end of the list. A great many cases are found between these two extremes and the factors which might be noted as contributing somewhat to their inability of readjustment are: suggestion on the part of the doctor, the relatives, or other patients, particularly those suffering from a similar injury, perhaps of a more severe degree; an unstable or nervous temperament, which almost universally leads to failure of readjustment, even though the injury may be very slight; last, repeated injuries of the same character to the same individual, each causing a more lasting impression upon his mental processes.

It is this group of cases which causes the greatest difficulty to the state Department of Labor and Industries in arriving at a just compensation and to insurance companies in estimating the amount of compensable disability and to the physicians who are called upon to make these estimations and evaluations. The Department of Labor and Industries is not to be classed exactly as the casualty insurance company because the department is not only authorized by law to make suitable compensation but also to re-insure the patient repeatedly. Insurance companies, on the other hand, have only to deal with one injury and that solely on a strictly monetary basis. What happens to the man afterward is no concern of the insurance company. The problem of the physician lies in an attempt to be fair to both parties and to see that no injustice is done on either side.

With these facts in mind, a study has been made of 100 cases falling in this last group, that is, those who have suffered an injury to the head and who have not been able to readjust themselves to the conditions found following the injury. In this are included 50 ventricular studies used as a check on the general physical examination. The examinations were all made at the request of the Department of Labor and Industries. Wherever there was a reasonable doubt that there was actually a physical lesion which could be the cause of the failure to readjustment, a ventricular study was done.

In the examination the following points were noted: the patient's age, date of injury, character of the injury as to consciousness or unconsciousness, time in hospital, time elapsing between the injury and the examination, the time the patient was out of work, the subjective symptoms, the cranial nerve examination, the general neurological examination, and the ventricular study. The ventricular studies included the pressure of the cerebrospinal fluid, the cell count, the character of the fluid, the Wassermann test, the X-ray showing changes in the size, shape, or position of the ventricles, and the presence of air over the cortex. Tables I and II are résumés of the findings in each of these instances.

While headaches are the most frequent complaint, they are very difficult to prove. Dizziness, while not as frequently noted as headache, should

[1] Presented in the Conference on Traumatic Surgery, before the Clinical Congress of the American College of Surgeons, Philadelphia, October 13, 1930.

TABLE I.—SUMMARY OF 100 CASES

Average age		42 years
Average time between the injury and examination		8 months
Number who have worked at any time since injury		24
Number who have not worked since injury		76
Chief complaints		
Headache		78
Dizziness		61
Loss of hearing		29
Loss of vision		27
Localized pain		27
General weakness		25
Loss of memory		13
Sensory disturbances		3
Positive findings		
Cranial nerves		
I.		3
II.	Œdema	36
	Atrophy	7
	Arteriosclerosis	4
III.	Ptosis	7
	External strabismus	1
VI.	Internal strabismus	1
VII.	Paralysis	left 1, right 3 4
VIII.	Tinnitus	4
	Nerve deafness	left 7, right 9 16
	Nystagmus	5
Inco-ordination		14
Reflexes: Deep—increased 23, decreased 8; superficial—increased 7; Babinski—positive 6.		

in a large number of cases be associated with positive physical findings, such as nystagmus and loss of hearing. Localized pain is difficult of proof and occurs quite frequently. This was differentiated from generalized headache. Disturbances of vision and hearing could be checked by careful testing which was done in most instances. General weakness could be more or less corroborated but this also is difficult to prove unless it is present to a marked degree. The temperament of the individual patient plays an important part in the evaluation placed upon symptoms by the examining physician.

In the examination of the cranial nerves the most striking findings are passive œdema, which manifests itself either by congestion of the vessels or a true swelling of the nerve head. Other changes in the cranial nerves were not of sufficient frequency to be considered. The changes in the deep and superficial reflexes were not particularly marked, increased reflexes being present in approximately 25 per cent of all cases.

The average age of the patients was 42, and the average time between the injury and our examination was 8 months. Only 12 of the 100 cases showed positive fractures in the X-ray pictures which were taken. We have then a composite picture of a man approximately 42 years of age, who, 8 months prior to our examination, had suffered an injury to the head which had caused subjective symptoms as severe headache, dizziness, general weakness, disturbances in hearing and vision, loss of memory, and localized pain; who presented practically no neurologic findings except increased reflexes and passive congestion of the vessels of the retina. In only 12 per cent of cases did X-ray examination show fracture of the skull, yet this (average) individual has been unable to adjust himself to his surroundings.

The records of the state show that in a total of 50 cases, the time loss was 695 months and 16 days, or an average per case of 13 months and 27 days of total time lost; of 35 cases, there is a total, permanent partial disability of 954.12 degrees, or an average of 27.26 degrees disability. Estimating the disability at thirty dollars per degree, this would mean that the average person receiving a head injury costs the state, in addition to his treatment, the sum of $817.80 for permanent partial disability (Table III).

In an effort to ascertain whether or not there is an actual physical disability in the majority of these cases, ventricular studies were done on those in which there was any question as to the presence of such a lesion. Penfield, in a report on a series of traumatic cases, emphasized the fact that there was accumulation of cerebrospinal fluid, local in character, which responded after insufflation of air. Fay later corroborated these findings and also added his observation of the general distribution of air over the frontal areas of the brain in traumatic lesions. In all cases we have been able to demonstrate this localized accumulation of air and also the general distribution of air as suggested by Fay.

The examinations were all done with patient in the upright position and the average cerebrospinal fluid pressure in the 50 cases was 28.5 millimeters of mercury. If we consider 20 millimeters as the highest normal cerebrospinal fluid pressure, it is apparent that an increased pressure is present in traumatic cases. The average cell count in these cases was 7, but this included 4 positive Wassermann reactions with high cell counts. If we exclude the 4 positive Wassermann reactions, the average cell count is 4, which perhaps is the upper limit for normal. Some authorities claim that anything above 2 cells is abnormal. The estimation of the sugar content in the cerebrospinal fluid shows an average of 59 milligrams, which is well within the normal range. In the tabulation of the X-ray films showing displacement of the ventricles, we find bilateral displacement in 2 cases, dilatation of the ventricles in 4, and compression of the ventricles in 4. In 13 cases, or 26

per cent, air showed over the cortex. The amount of air injected varied from 25 cubic centimeters to 40 cubic centimeters. Undoubtedly if 100 cubic centimeters of air had been used, we might have found more cases but any marked degree of cerebral atrophy will be easily demonstrated by use of 25 to 40 cubic centimeters of air, so we feel that these figures are quite accurate.

In glancing at the subjective symptoms, we find disturbance of hearing, disturbance of vision, localized pain, and general weakness in about the same percentage of cases as we find distribution of air over the cortex. Practically all of the cases showing air over the cortex complained of these symptoms. There does not seem to be any relation between the degree of headache and dizziness and the ventricular findings of air over the cortex or disturbance in the ventricular system. As practically all of the patients on whom a ventricular study was made complained of both headache and dizziness and only 25 per cent showed cortical air, it is fair to assume that only 1 in 4 actually is suffering from severe headache and dizziness.

This brings us then to the discussion of the relative value of the history of the patient, physical examination, and the ventricular study in these cases. Obviously the history of the case, while important if combined with the patient's statement as to symptoms, is of value in only 25 per cent of the cases. Nor does the physical examination yield much more information. The ventricular study is more accurate and gives positive findings. Particularly is this true in the case of a general œdema and it also suggests the treatment which is of greatest benefit to these patients, namely, dehydration followed by limitation of fluid intake. It is not going to be possible to secure ventricular studies on all questionable cases nor is it going to be possible to estimate exactly the degree of compensable injury, but it is going to be possible for the medical profession to give better treatment at the very beginning of the injury. This, no doubt, will do away with many actual disabilities. It will not help those patients in whom there is a tear of the arachnoid with accumulation of cerebrospinal fluid about the cortex, as first noted by Naffziger.

Secondly, we must look forward to the time when all those engaged in active industry shall have to submit to a physical examination and have noted the actual condition present at the time of securing the position. An injury subsequent to this examination can be checked by the previous physical condition of the patient.

Lastly, there must be in industry, just as there is in our colleges today and in the business world, a reclassification from the standpoint of temperament and adaptability. Men who are constitutionally psychopathic to begin with cannot be permitted to enter the hazardous occupations where the slightest injury will bring about claims for complete and total disability. Perhaps this is looking far into the future but already large companies, such as the Standard Oil Company, for instance, the United States Steel Corporation, and even many of the chain stores, are insisting upon physical examinations at the time of employment and rejecting all those whose temperament unfits them for positions of a certain nature. Industry must either assume a tremendous burden which will include these temperamentally unfit as well as the malingerers in the final summing up of their compensable cases, or else must exclude these prior to an injury.

TABLE II.—SUMMARY OF 50 VENTRICULAR STUDIES

Cerebrospinal fluid pressure—average 28.5 millimeters; color, clear 48, amber 2; cells, average 4; Wassermann reaction, negative 46, positive 4; sugar, average 59 milligrams.	
X-rays	
Displacement, bilateral to the left	2
Dilatation of the ventricles	4
Compression of the ventricles	4
Air over cortex of frontal lobes	13
Practically normal shadows	27
Fractures	
Depressed	5
Linear	2
Stellate	4
Left parietal exostosis	1
	12

TABLE III.—ECONOMIC SUMMARY

Time loss for 50 cases	
Total	695 months, 16 days
Average	13 months, 27 days
Permanent partial disability for 35 cases	
Total	954.12 degrees
Average	27.26 degrees
Cases on time loss, no particular treatment	11
Cases still receiving treatment	2

REFERENCES

1. Fay, Temple. West Virginia M. J., 1925, xx, 281–288.
2. Idem. Some factors in "mechanical theory of epilepsy." Am. J. Psychiat., 1929, viii, 783–835.
3. Idem. Generalized pressure atrophy of brain, secondary to traumatic and pathologic involvement of pacchionian bodies. J. Am. M. Ass., 1930, xciv, 245.
4. Fay, Temple, and Winkelman, N. W. Widespread pressure atrophy of brain. Am. J. Psychiat., 1930, ix, 667.
5. Naffziger, H. C. J. Am. M. Ass., 1924, lxxxii, 1751.
6. Penfield, W. G. Cerebral pressure atrophy. Presented before the Association for Research in Nervous and Mental Disease, December 28, 1927.

RUPTURE OF THE SUPRASPINATUS TENDON[1]

ERNEST AMORY CODMAN, M.D., F.A.C.S., BOSTON

I BELIEVE that rupture of the supraspinatus tendon is the most common industrial injury causing prolonged shoulder disability and that more lost working days may be charged to it than to all the other industrial shoulder injuries combined. Furthermore, although the suffering from it is chiefly of a subacute nature, this lesion is the most painful of shoulder injuries because of the prolonged and persistent character of the symptoms. I contend that the diagnosis of the more serious types of these cases can readily be made and that suture of the tendon should be done at once and that thereby the economic loss may be greatly reduced. In the following paper I have endeavored to outline the reasons which have led me to form these convictions.

I realize that any surgeon who is particularly interested in a form of disease or injury, especially if he has been the pioneer in pointing out the existence of such a condition, becomes badly biased and tends to be blind to its relative importance compared to other lesions. In the present instance, since I believe that I was responsible for the first operation (March 7, 1909) performed on a ruptured supraspinatus tendon, and that I was probably also the first to call attention to the existence of this lesion and to the syndrome by which it may be diagnosed, I am on my guard not to exaggerate.

Nineteen years ago[2] I reported 2 cases and since I was able to follow these patients for many years, I know that the late results were satisfactory. Although the second patient never had perfect abduction, he worked for a neighbor of mine, so that I was able to see just what he could do, and to verify the fact that he worked uncomplainingly with that arm for over 10 years.

There are still many surgeons who have not even heard of rupture of the supraspinatus tendon and to whom my statement that these lesions form the bulk of cases where industrial shoulder disability is prolonged, will seem preposterous. I rest my case on 18 arguments as follows:

1. *A priori.* Notice that in one paper[3] I presupposed, on anatomical grounds, the probable existence of such lesions and stated that "One theoretical symptom (since the supraspinatus is put out of action) should be the persistence of passive and loss of active abduction." I had to wait for 3 years before finding an appropriate case in which to make a definite clinical diagnosis and to plan deliberately to suture the tendon. If one can anticipate from anatomical conditions that a certain lesion should occur and then finds that it does occur, it tends to make one's convictions strong, even if backed by only 2 cases. Since then, I have operated on at least 36 more cases.

2. *The fact that the condition is definite enough to be diagnosed with considerable certainty* makes its existence as a clinical entity all the more sure. In a recent review of 500 shoulder cases in which I have written reports to the Industrial Accident Board or insurance companies, I found that I had made the diagnosis 122 times, and there were at least 12 other cases in which the diagnosis was made in conjunction with other lesions, as dislocation or circumflex paralysis. Practically all cases of traumatic subdeltoid (equals "subacromial," which term is preferable) bursitis are due to ruptures of the supraspinatus tendon. Partial or minor ruptures are more common than complete ones.

The symptoms on which the diagnosis of complete rupture is made are as follows: The patient is generally past the middle of life, usually a working man. There is always an adequate trauma; such a trauma as would produce a near-dislocation. Sometimes the violence is clearly indirect, as in the case of a woman who threw a heavy wet blanket over a line. I doubt if it is ever direct, although we often get the history as such. In other words, in case of a fall, the patient, probably always unconsciously, suddenly throws his arm up to retain his balance, rather than falls on his shoulder as he usually tells you he does. One can hardly fall to the ground without outstretching the arms. At the time of the injury, the patient feels a sharp pain in the shoulder. He may attempt to work afterward and often he soldiers out the rest of the day, but that night he usually lies awake. "I walked the floor all night," is a common expression, although probably seldom really true. Usually the next morning the patient is unable to work and reports to the foreman and is seen by a doctor who does not recognize the lesion but applies liniment or a bandage and perhaps has an X-ray picture taken which is reported negative. Each morning the patient states that he has suffered all night and cannot use the arm, yet to appearances there is little to

[2] Boston M. & S. J., 1911, clxiv, 708–710.

[3] Boston M. & S. J., 1906, May 31.

[1] Presented in the Conference on Traumatic Surgery, before the Clinical Congress of the American College of Surgeons, Philadelphia, October 13–17, 1930.

show for his complaint. Usually he does not work again for months or years. If he is a very hardy individual and his work does not require much abduction, he may, nevertheless, go on with the job for a short time but his nights remain painful, motions of his arm are painful, he loses in his general condition, and after a few weeks or, rarely, after a considerable number of months he has to quit. Meantime his physicians have given him little sympathy because there is no definite evidence of dislocation or fracture. I may say that I would personally greatly prefer a fracture of the upper end of the humerus to a complete rupture of the supraspinatus tendon, yet a patient with the latter diagnosis is up and about all the time. Nevertheless, he suffers a greater total amount of pain, for his subacute distress lasts for years.

Now if every doctor who examines industrial injuries of the shoulder knew that the signs were distinct when this lesion had occurred, the diagnosis would be made early instead of late, and the tendon could be sutured back in place. The signs of a typical case are as follows:

Later than 3 weeks after the injury, there is atrophy of the supraspinatus and infraspinatus muscle, and perhaps slight atrophy of the deltoid, but the atrophy shows chiefly in the spinati by the prominence of the spine of the scapula. Later the deltoid is often hypertrophied on account of the extra work thrown on it. Usually there is no great restriction of motion by adhesions but during the first few days there may be limitation from spasm of the shoulder muscles. The patient will not voluntarily raise his arm, but if the rupture is not a very severe one, he can, with encouragement, elevate it to a vertical position, or it may be passively raised. This elevation of the arm, however, is not accomplished with the normal scapulohumeral rhythm between the motion of the scapula on the chest wall and the motion in the scapulohumeral joint. Instead, during the 180 degrees of the complete arc of motion, the scapula and humerus will move together for part of the way, then after a jog and wince, the humeral joint will move and the arm rise to its complete position. This change in the scapulohumeral rhythm is accomplished with an evident jog as the tuberosity of the humerus passes under the acromion. This jog in motion is accompanied by a crepitus which the examiner may feel by holding his finger just below the tip of the acromion process. A characteristic soft crepitus occurs. The X-ray examination frequently shows roughening of the tuberosity in old cases.

In the stooping posture abduction may be performed without this syndrome, because it is performed by gravity without muscular effort and the weight of the arm needs no fulcrum or leverage to bring it into an abducted relation with the scapula. Formerly[1] I thought this indicated hysteria; now I do not. However, it is a very useful test in diagnosis and should be understood thoroughly by everyone interested in this field of surgery.

When the arm is in the normal position of adduction at the side, the examiner will find a slightly abnormal change in the contour of the tuberosity of the humerus just external and anterior to the tip of the acromion. This change in contour is made more evident by drawing the patient's elbow backward, which maneuver throws the superior surface of the head of the humerus forward and makes it readily palpable. The change in contour consists of an eminence just proximal to which is a sulcus. The eminence is the tuberosity from which the tendon has been evulsed. The sulcus is the depression made where the fibers of the tendon should be, between the tip of the tuberosity and the edge of the cartilaginous surface. There is usually, but not always, decided tenderness at this point and this spot of tenderness, when the arm is abducted either actively or passively, disappears under the acromion. As it disappears, the jog, wincing, and crepitus occur. The tender spot, with the eminence and sulcus, rotates as the humerus rotates when the forearm, with elbow flexed at a right angle and at the side, is turned inward toward the body and outward toward the saggital plane.

Characteristic as is this syndrome of a tender rotating point which disappears under the acromion with crepitus, jog, and wincing as the arm is abducted, the behavior of the shoulder joint as the arm descends, is quite as diagnostic. These patients, when they let the arm descend from the upright position, almost invariably keep the shoulder blade firmly fixed to the humerus in abduction, then lower shoulder blade and arm as one piece until they reach a horizontal position, when, with a sudden cringing and wincing, they relax the muscles, lean toward that side, and drop the arm, which falls rapidly through the 90 degrees of its scapulohumeral motion. In other words, they can hold the arm in complete abduction but not in semi-abduction of the true scapulohumeral joint. Formerly I would not make a diagnosis of complete rupture unless the patient positively could not actively abduct and yet passive abduction was possible. Now I know

[1] Boston M. & S. J., 1912, clxvi, 890–891.

that I was over-conservative and that weak active abduction with a jog can usually be performed even when the whole tendon is torn. Complete loss of abduction usually means a very extensive injury, involving adjoining tendons.

A sign which is of some value to me and will in future be of value to others who have seen a number of these cases, is the change of contour in the deltoid region as the two arms are compared when elevated to a vertical position. In this position, the fluid of the joint is driven upward into the subdeltoid portion of the bursa by the tenseness of the lower part of the capsule. The distended bursa pushes the upper portion of the deltoid upward, so that the folds of skin between the shoulder and neck are changed. The presence of this fluid accounts for the slight limitation in extreme abduction which is also characteristic of the severe cases.

These symptoms which have been described not only are characteristic of rupture of the supraspinatus tendon, but in their entirety are quite unlike those of any other lesion affecting the shoulder joint, except certain stages in the condition called "calcified subacromial bursitis" which is really a condition of calcification in the supraspinatus tendon. Fortunately the X-ray picture usually settles this point and since it is only occasionally that confusion in diagnosis occurs, it seems hardly worth while to take the space to discuss it.

I have made the diagnosis of rupture certainly over 200 times. I have operated on this diagnosis 44 times and was correct 38 times.[1] Since I have known good general surgeons who are not familiar with this condition to miss this diagnosis and since I know by operative proof that I can usually make it, the above convictions are strengthened.

3. *On the basis of time and experience.* The claims which I made in the paper above quoted I think were not exaggerated. Even then, I strongly suspected that rupture of the supraspinatus tendon was the most common shoulder lesion of importance; time and an experience with over 1,000 cases of shoulder injuries have merely strengthened my conviction, until now I feel able to state before this society, that I am confident.

4. *The frequency with which rupture of the supraspinatus occurs with other lesions about the shoulder, especially with dislocation,* strengthens my convictions. In the group of 500 cases alluded to, there were at least 12 such concomitant lesions. Dr. Akerson found about the same relative number in his series of observations on the cadaver (Table I). These facts seem to me to support the supposition that it is to be expected that the lesion will occasionally be found as the only evidence of trauma when a dislocation has immediately become spontaneously reduced. Occasional cases in which a dislocation has been reduced and yet incapacity continues may be due to this lesion, especially if it has evulsed the facet of insertion.

5. *Occurrence with circumflex paralysis.* My opinions have been strengthened by the following observations in connection with the function of the supraspinatus tendon, injured and uninjured. From my study of the shoulder joint, in 1906, I concluded that the supraspinatus by itself could elevate the arm. I searched the literature and at last found that some of the older French writers, especially Duplay, had reported cases in which this had been observed. My experience since that time covers several cases which demonstrated this fact, especially one industrial patient who had had infantile paralysis of the deltoid, and whose supraspinatus developed to an astounding extent, so that he could actually do laboring work and, incidentally, foist his old lesion on the Compensation Board of Massachusetts as a recent one.

If a patient has paralysis of the deltoid alone and his supraspinatus is uninjured, he can elevate his arm, and vice versa, if the latter muscle is also paralyzed or if it has been ruptured, he cannot. I therefore recommend exploratory operation of the bursa in any case of uncomplicated deltoid paralysis following injury in which the patient cannot with a will slowly raise his arm. In two such cases I have found the supraspinatus tendon torn. In another case in which I explored I found the tendon intact, which proved the corollary by prompt recovery, as the paralysis of both deltoid and supraspinatus soon cleared up. Now while these 3 cases are only 3, they show to my mind a *finesse* which could not have been achieved unless my general proposition about the importance of supraspinatus injuries was correct.

6. *An exaggerated case.* A case in which all the short rotators were torn from their insertions on the tuberosity, without fracture of the humerus, is convincing by its extreme character. I have not uncommonly found the infraspinatus torn as well as the supraspinatus. Occasionally, the tear extends into the fibers of the subscapularis, but in this case all the four short rotators were torn

[1] This statement may not be exact because there was a period when I may have operated upon a few cases and have lost my notes. It is substantially correct, however, for I have been very conservative and have operated only on the bad cases with outstanding symptoms. In the 6 cases of failure to confirm the diagnosis there was reason to believe that the tendon had been partially ruptured although no communication existed between the joint and the bursa as had been found in the other 38 cases.

TABLE I.—DR. AKERSON'S FINDINGS IN AUTOPSY EXAMINATION OF ONE HUNDRED SHOULDER JOINTS

	Cases
Both shoulders examined	48
Right shoulder only	2
Left shoulder only	2
Total autopsies	52
Sex	
Males	37
Females	15
Total cases	52
Ages	
46 to 59 years	7
60 to 79 years	35
80 and over	10
Total	52
Shoulders affected	
Right	50
Left	50
Total	100
Rupture of supraspinatus found	
Right (46 per cent)	23
Left (32 per cent)	16
Average (39 per cent)	39
Degree of ruptures	
Large enough to show the articular surface on opening bursa	21
Smaller than this but still quite apparent	18
Total	39
In 39 cases the supraspinatus was ruptured either alone or in combination with adjoining tendons as follows:	
With portion of subscapularis	6
With portion of infraspinatus	10
With infraspinatus and teres minor	2
With all other short rotators (in same patient)	2
Condition of biceps tendon in 50 joints (in the first 50 joints, these observations were not recorded).	
Exposed to view in gap	1
Could be pulled into gap	2
Evulsed from glenoid	6
Flattened	4
Frayed	5
Total	18

In only one case was a lesion found in other tendons (a small lesion in the infraspinatus) when the supraspinatus was intact.

The joint cartilage showed erosion in 24 cases in which the supraspinatus had been torn. No erosion was shown in any case in which the supraspinatus was not torn or when the tear was so small as not to expose the bone or cartilage when the bursa was opened. The amount of erosion was usually proportionate to the extent of damage in the tendon.

TABLE II.—DIAGNOSIS IN FIVE HUNDRED CASES OF SHOULDER INJURIES REPORTED BY AUTHOR

	Cases
Trivial or no diagnosis	100
Acute subacromial bursitis	6
Adherent subacromial bursitis	17
Fringes and bands in bursa	14
Calcified deposits	25
Fractures of the tuberosity	26
Extensive fractures	38
Circumflex and other nerve injuries	36
Constitutional arthritis	13
Ruptured biceps	9
Ruptured supraspinatus	122
Acromio-clavicular arthritis or dislocation	30
Malingering	7
Hysteria	21
Miscellaneous rare cases	36
Total	500

Each case appears under only one diagnosis, although oftentimes two of these diagnoses are combined. The cases classed as "trivial or no diagnosis," were excluded from the study because they were cases in which I myself was in doubt. Many of these I believe to have been minor ruptures of the supraspinatus tendon in which the typical symptoms were not fully developed. Besides the 122 cases in which the diagnosis of rupture of the supraspinatus was made, I believed that this condition existed twelve times in combination with some one of the other lesions, as circumflex paralysis, etc. Thus we find that I made the diagnosis of supraspinatus injury at least 134 times in the 500 cases, and it is my opinion that minor lesions of this tendon were present in many more. In other words, the proportion was upward of 26 per cent in the whole group. Since none of the other lesions are nearly so protracted in their course, I believe that in this particular group, the total time lost was greater than from all the other lesions together.

It might be said that my colleagues would refer a case to me only if they had a suspicion that this lesion existed. I do not think this is, as a whole, true. This group of cases was, in the main, sent to me because there was a dispute between the patient and the insurer as to the nature and extent of the disability; therefore mostly chronic cases. The table does not represent the relative numbers of acute shoulder injuries, but of prolonged obscure lesions. Notice that my convictions stated in the first paragraph of this paper, refer to *prolonged* disability.

from the head of the humerus. The patient was an active, muscular roofer who fell from one roof and caught his abducted arm on a piazza roof below and thus checked his fall, but ruined his shoulder. He had a combination of most of the complications of dislocation of the shoulder; i.e., rupture of a large axillary vessel, partial paralysis of the brachial plexus, evulsion of the long head of the biceps and of the short rotators, as well as complete division of the capsule. It illustrates the extreme at one end, while rupture of a few fibers in a healthy young man who growls and continues to work is the other extreme. Another lesson is taught by this extreme case. The dislocated shoulder was reduced in the dispensary of one of the best conducted hospitals in this country without the complications being recognized. After reduction of a dislocation one should always test all the active motions of all the muscles, except the combination of abduction and external rotation. The shoulder cannot dislocate again in abduction if internal rotation is maintained.

7. *The supraspinatus tendon is a very firm, strong structure.* This fact was confirmed at operations in which I have sutured this tendon, sometimes many months after the injury, when the retracted tendon was almost functionless. A few lesions operated on within a few weeks after the

injury had the look of recent wounds. I have never operated in less than 3 weeks from the time of the injury because I have never had the opportunity, since my work has not been in the accident field. It tends to the conviction that these ruptures are of traumatic origin rather than due to disease in the tendon.

8. *Pathological examination.* A large number of specimens obtained at autopsy show no lesion which is incompatible with a traumatic theory, although the structure of the tendon adjacent to the rupture is always found to be abnormal. This may be wholly post-traumatic in consequence of the rupture, but probably is partly due to a senile change in the tendon before the rupture.

9. *The results.* That in some of my operations a perfectly useful joint has been secured after suture of the tendon even weeks after the injury tends to convince me that the lesion was essentially of a traumatic nature and that immediate repair of the tendon should be made. Furthermore, since in most cases the rupture is usually found to be more extensive than the clinical signs indicated, the operator becomes more and more inclined to interpret milder cases which he has not operated upon as probably having been minor lesions of this tendon.

10. Continued incapacity, unless operation is performed and even sometimes when it has been, enhances the conviction that these lesions are serious and painful. Many cases in which I advised operation and in which such operation was never done, had a long period of incapacity. Some never worked again at their former occupations.

11. *Minor ruptures.* Hitherto I have been speaking mainly of the major lesions when the whole tendon was ruptured or evulsed from the facet and the joint cavity has been thrown into communication with the bursa. Experience both in the operating room and on the cadaver at autopsy, as well as clinically, show that there are many minor lesions in which the tendon is partially torn without producing a communication entirely through the tendon into the bursa. As time has gone on, I have become able to diagnose these minor lesions. In the cadaver, it is difficult to find cases in old working people in which none of these minor lesions are found. The ruptured fibers in these cases may be on the bursal side, the joint side, or in the midst of the tendon, but enough fibers remain to prevent fluid from passing between the joint and the bursa. I have not operated intentionally on these partial ruptures but they account for many days of disability and are usually diagnosed as strains, neuritis, or bursitis.

12. *Dr. Akerson's figures.* During the last year, my clinical conclusions have been amply confirmed by the examination of a series of shoulder joints by Dr. I. B. Akerson of the pathology staff of the Harvard Medical School. In the course of postmortem examinations of a series of 100 shoulder joints at a large municipal hospital for chronic, indigent cases, Dr. Akerson found that in 39 per cent some lesion of the supraspinatus tendon was evident. In 21 of these, the rupture was extensive enough to make a communication between the joint and the bursa (see Table I).

13. *Clinical statistics.* From a recent review of 500 shoulder cases reported by the author, Table II was compiled.

It is true that it was the writer who so many times made the diagnosis of rupture of the supraspinatus; it was not some other surgeon who had never heard of the lesion. You must consider the case of "Hobby versus Ignorance."

14. *Dissecting room subjects.* For several years I made it a practice to open the bursæ of the anatomic subjects at the Harvard Medical School. I always found instances of one or more ruptures in a set of 20 subjects. I became convinced of the frequency of the lesion and I found the fact very useful because if I wanted to show some visiting surgeon an example, I felt confident that if he would take the trouble to come with me to the dissecting room, I could show him one. Furthermore, if I went to some other city to talk on the subject of shoulders, I felt very confident of being able to pick up a patient from an out-patient department to demonstrate. I have little doubt today, that in every large out-patient department or industrial clinic in the country, there are these neglected cases of rupture of the supraspinatus tendon, who cannot work and who vainly seek relief.

15. *The fact that the biceps is frequently injured with the supraspinatus* has misled many surgeons. They attribute the supraspinatus symptoms to the obvious biceps lesions. In many patients on whom I have operated, the long head of the biceps was also ruptured. In his postmortem study, Dr. Akerson found in a number of cases a similar associated condition. In my opinion, rupture of the long head of the biceps alone is a trivial matter, but the biceps injury combined with the supraspinatus injury is serious, because the long head of the biceps does help to stabilize the head of the humerus on the glenoid.

16. *Confirmation by other surgeons.* Although, for 25 years, I have talked occasionally about this condition, it is only recently that an article has

appeared by another surgeon, which not only confirms my own views, but by a report of 8 successful cases done by a new and improved technique, offers more hope for the patients. I allude to the article by Dr. Philip Wilson, recently read before the American Orthopedic Association. The results of my own operations have been fairly good but as all have been in old cases—weeks, months, and even years after the injury—they have seldom been perfect and are never prompt in obtaining function. A few were failures. Most of my operations have been worth doing but I am sure that operations done immediately after the injuries would have been much more prompt and more satisfactory in their results.

17. *The supraspinatus is almost always ruptured if the other adjacent tendons are ruptured.* The following sentence concerning this point is from an article that Dr. Akerson and I have written together, which will appear shortly in *Annals of Surgery:* "In only one case was a lesion found in the other tendons (a small lesion in the infraspinatus) when the supraspinatus was intact."

18. If you will open the bursæ in patients who have the symptoms I have described, I am sure that you will find that my convictions are your convictions and this fact will become my best argument for my first paragraph.

Thus far I have given you my reasons for believing in the frequency and importance of traumatic rupture of the supraspinatus tendon and for my faith that such lesions may be readily recognized and repaired. Now let me give you six reasons for supposing that these lesions are not wholly of traumatic origin but perhaps are partly the result of the condition which we vaguely call arthritis. All six should be weighed in your judgment before accepting the ideas I have advocated.

1. *If a pathologist opened a shoulder joint and found a defect originally caused by one of these lesions,* he would almost certainly pass it by at a glance as an instance of arthritis and would not stop to think of a possible traumatic cause. This common condition has remained unnoticed for years, just as did appendicitis. Although pathologists were opening the abdomen for peritonitis, they failed to see that the usual cause of peritonitis was a perforated appendix. It is my opinion that in this relatively small field where only pain and incapacity are involved, history is repeating itself. However, pathologists in the course of an autopsy seldom do open the shoulder joint, and even then, do not explore the joint by way of the bursa as did Dr. Akerson. Pathology, hitherto, has concerned itself mostly with the causes of death and has given little consideration to the causes of chronic pain. As a matter of fact, little or nothing has been written on the pathology of the bursa and of the tendons of the shoulder. The amount of work which Dr. Akerson has done on this series of cases probably exceeds that of all the other pathologists in this country put together. However, there are certain striking things in his findings to which I may call your attention, as indicating that some of these defects in the tendon may be preceded by tendinitis.

2. *The age.* Almost all the subjects upon which he performed these autopsies were elderly people but I have had some personal experience to support the supposition that these injuries do not occur in young people, because I have been able to open a considerable number of bursæ in young subjects in the dissecting room and at occasional autopsies in the hospitals, and I have never yet found a rupture of the supraspinatus tendon in a subject under 20 years. Moreover, the ages in my group of 122 averaged 53 years. The youngest was 21, but the youngest patient in whom the diagnosis was confirmed by operation was 38 years. Dr. Akerson's figures would not prove that this lesion occurred only in elderly subjects, for all his subjects were elderly and he had no means of telling how many years before death each lesion had occurred. He was dealing with defects left by previous injury or disease. Clinical histories were lacking and it is doubtful whether the aged poor would remember sore shoulders which had troubled them many years before, even if direct questions had been asked. However, my own clinical experience leaves me in little doubt that these injuries occur after middle life, when the tendinous structures have lost their elasticity. Certainly, aged tendons are thinner and weaker as compared to the bone they are inserted in, while the reverse is true in young subjects. This may be the reason why the lesion so seldom occurs in the young. Rupture of the tendon of the quadriceps femoris occurs only in later life because in the full vigor of life, the patella gives first. So it may be with fracture of the tuberosity in shoulder lesions.

3. *The class of life.* This is a lesion of working people. May it not be the result of overuse of the tendon which may become atrophied from abuse or from repeated strains? This is possible, but I have at operation found very strong tendons, once the new-formed edges are cleared away. It is a fact, however, that I have but once made a diagnosis of this lesion in a person of the non-laboring classes. Possibly continued abuse does result in weakening of the tendon.

4. *We find arthritis in all the other joints, why not in the shoulder?* This joint is not a joint in the ordinary sense of a hinge or pivot. The shoulder is a sling with only muscles and atmospheric pressure to hold the surfaces in apposition. Its structure does not make it prone to the usual phenomena of arthritis. Arthritis if present could only be peri-arthritis and this could only be tendinitis, for the conjoined cuff of tendons of the short rotators really forms the joint. The joint consists of tendons and muscles; the capsule is lax. Tendinitis does exist, for the so-called calcified bursitis is really due to calcified deposits in the tendons and the bursitis is only secondary when one of the deposits creates inflammation of, or discharges into, the bursa, or when trauma ruptures the remaining fibers and spreads the material in the bursa. Cases of tendinitis without calcification are not uncommon and are diagnosed as bursitis, arthritis, neuritis, and rheumatism.

5. *In Dr. Akerson's series the defects in the supraspinatus were often bilateral.* The calcified cases are also well known to be often bilateral. May Dr. Akerson's findings not be the results of these deposits which had disappeared years before and left defects in the tendon? This seems to me not improbable, but on the other hand, I have seen and operated upon many patients with calcified deposits and noticed no after-effects. Removal of these deposits has resulted in a satisfactory, prompt, and permanent cure. The pain in these cases before operation may be very acute for a time, but the suffering is insignificant and trivial compared to the long period of pain and disability in cases of traumatic rupture of the supraspinatus. However, I think we have good pathological evidence to show that these calcareous lesions may leave a permanent defect in the tendon which might predispose to rupture. There is also some evidence to indicate that these deposits themselves are caused by imperfect healing of minor ruptures of the interior tendon fibers. They may occur in somewhat younger people than do ruptures. In my series the average age of the patient with rupture was 53 years, while that of the patient with the calcified lesions was 40 years.

Dr. Akerson is working on the pathological histology of both lesions. There is a decided resemblance in the way the tendon is affected, as well as in the bilateral similarity. It seems quite probable that tendinitis may precede both lesions and that perhaps rupture of a tendon is more likely if a calcified deposit had affected the tendon years before. Certainly I have some good clinical evidence that, even while a calcified deposit is present, traumatic rupture of a few more fibers may spill the soft, calcareous material into the bursa, thus producing in a moment an extremely painful, acute, subacromial bursitis.

6. *Literature.* There is no literature on the subject of this paper. There is a considerable one on the peculiar calcified deposits alluded to under the last heading. Clinically, the findings in the presence of these deposits differ widely from the findings in cases of rupture of the supraspinatus tendon. The lesions are trivial and are readily relieved by removal of the deposits through a small incision. The calcified material may undergo spontaneous absorption and the patients may recover without any treatment or in spite of any treatment. In a given case it is impossible to tell how long the course will be. Patients with very acute conditions may be well in a few weeks or a chronic phase may last for months. In complete rupture of the supraspinatus, quite the contrary is the case. We are sure of a long, painful course with perhaps permanent incapacity. The operation for suture of the tendon is much more difficult and the condition is altogether a more serious matter. Therefore, the two clinical entities should not be confounded.

The only articles worth mentioning which pertain to the title of this paper are those by Dr. A. W. Meyer, professor of anatomy at Leland Stanford University, and yet their titles do not mention the supraspinatus. Nevertheless, I am confident that Dr. Meyer has been studying the same lesions on the dissecting room table which Dr. Akerson has found at autopsy and I have found in industrial cases. Dr. Meyer's attention has been concentrated on the biceps tendon, while I believe that rupture of the supraspinatus is the primary and important lesion. I cannot agree with Dr. Meyer, but his work demands respectful study as an explanation of the same lesions discussed here. He believes the lesions to be the result of friction.

I cannot conclude this paper without a mention of my particular hobby of hospital efficiency. I hope that what I have said will not lead to unnecessary experimentation on all sorts of patients with sore shoulders. I hope that every large clinic will appoint one or two earnest young men to study injuries of the shoulder and to do the operations in this field and not leave them to be done by busy surgeons who try everything once without proper preliminary study of the local anatomy and pathology. There is little danger in operating on this condition as far as life is concerned but there is danger of unnecessary suffering by postponing the day when the operation can

become standardized, in daily use, and promptly and efficiently done. No other treatment can be of much importance except possibly fixation in abduction for several weeks after the accident. From the nature of the lesion, physical therapy can be of little help. My aim has been to insist on a general recognition of the existence of this condition as a definite clinical entity with a clear-cut set of signs and symptoms. When this has been realized by the profession in general, it will be time enough to discuss the technique of operation. I am sure that any surgeon who knows the local anatomy would find the operation simple and effective if done within a few days of the injury. The real difficulty lies in educating those who give the first treatment in industrial injuries, for as in most other injuries and wounds, the first treatment is the important one. It will be easy to suture the freshly ruptured tendon. I have found it hard but possible to get some good results in long-standing cases. Let the young men who attend the accident wards do these operations promptly rather than let the old men attempt them months after the proper time.

BIBLIOGRAPHY

MEYER, A. W. Absence of the tendon of the long head of the biceps. J. Anat. & Physiol., 1913–1914, xlviii.

Idem. Unrecognized occupational destruction of the tendon of the long head of the biceps brachii. Arch. Surg., 1921, ii, 130.

Idem. Further observations upon use-destruction in joints. J. Bone & Joint Surg., 1922, iv, 491.

Idem. Further evidences of attrition in the human body. Am. J. Anat., 1924, xxxiv, 241.

Idem. Spontaneous dislocation of the tendon of the long head of the biceps brachii. Arch. Surg., 1926, xiii, 109.

Idem. Spontaneous dislocation and destruction of tendon of long head of biceps brachii; fifty-nine instances. Arch. Surg. 1928, xvii, 493–506.

MEDICINE IN INDUSTRY FROM THE STANDPOINT OF THE EXECUTIVE[1]

P. C. STAPLES, PHILADELPHIA
Vice-President of the Bell Telephone Company of Pennsylvania

IN the short time allotted to me I shall attempt to tell you what we are doing in the medical department of the Bell Telephone system, why we are doing it, and the results we hope to obtain from our work. I shall confine my talk to the work of the Bell Telephone Company of Pennsylvania which is the operating organization of the Bell Telephone system in Pennsylvania with a subsidiary company in Delaware. Our medical department is about 15 years old. It was introduced at the time when business was going into that great expansion of 1912, 1913, and 1914, and our plant was expanding tremendously. Our intake was very, very heavy. We then served, as we now serve, a territory of approximately 350 miles from east to west and approximately 150 miles from north to south. Our organization numbers something like 25,000 persons of whom approximately two-thirds are women. The woman force is largely concentrated in the traffic department, the operating department, the department which operates the switchboard. These young women are from 17 to 30 years of age, most of them have had a high school education, and they come from homes in the middle walks of life. Probably 75 per cent of these women employees are divided into groups of from 25 to 300 people, who work in what we call telephone operating rooms. In that force the turnover is pretty heavy, necessitating a very sizeable, continuous intake. The service is such as to require a reasonable alertness of all the mental faculties which go with good health and good conditions.

In the plant department of the business, in which the men are employed, the work is underground or overhead. There are no particular hazards in connection with the work, except those that go with work aloft. There are no very dangerous currents to handle, although at times our men are brought into close proximity with high tension currents.

We have, as we see it, no vocational diseases. The exactions on girls in the operating department are not serious, although they are positive. Telephone operating seems to produce no disarrangements of health which we might characterize as vocational disabilities.

We should remember that ours is a young organization in point of years and that approximately two-thirds of the force are young women, who, in general, seek employment not to make telephone business their life's occupation, but to make sufficient money to tide them over a period of 2, 4, 6, or 8 years until they marry, so that most of our losses are produced by the effects of this condition.

We have here, as in all Bell Telephone Companies, the usual workmen's compensation laws and we have a benefit plan provided by the company without assessment of employees, which quite liberally provides sickness and accident benefits—accident benefits in excess of legal benefits.

Right here may I confess that there is financial motive in medical work with us. We do not do it from any eleemosynary sense; we do not carry paternalism quite that far. We are in industrial medicine, if that is what you want to call it, because we think it is profitable to ourselves and to others.

The fundamental structure of our medical department consists of, first, a medical director, who is, of course, a professional man. He reports to the vice president of the company and has two quite sizeable medical offices, one in Philadelphia and one in Pittsburgh. Let me give you briefly the dimensions and something of the organization of those two offices. In Philadelphia, the medical office under direction of the Philadelphia medical officer, Dr. Taylor, has 12 examining physicians, 4 nurses, 2 nurse technicians, 8 clerks, 1 roentgenologist. In Pittsburgh, under the direction of Dr. Jones, we have 6 examining physicians, 2 nurses, 1 nurse technician, and 4 clerks. The doctors are on part time. Rightly or wrongly, we believe that we get a more spirited and effective administration of medical work at the hands of doctors who have sizeable outside practices; although we pay some penalties by not having the undivided time of our professionals, we believe we have the better arrangements in the one I have described. The remainder of the organization, of course, is entirely on a full time basis.

In order that doctors may not be burdened with all the minutiæ attending the clearance of people and the setting up of interviews for them, we have what we term a two line, bilinear, type of organization, that is, the work of the medical

[1] Presented in the Conference on Traumatic Surgery, before the Clinical Congress of the American College of Surgeons, Philadelphia, October 13–17, 1930.

department is divided into routine and professional work. The professional work is under the direction of the medical officer. The routine work is under the direction of the medical office manager. The medical office manager and his clerks try to keep the decks clear for the doctors. The clerks handle the people as they come in and out, keep the records, make the assignments, and do all of the things which in a doctor's office is done by a secretary. There appears to be perfect co-operation and collaboration between the professional and the non-professional elements of our medical office work. The two medical offices handling Philadelphia and Pittsburgh, of course, cannot begin to cover the territory I have described to you and we do not have sufficient funds to have medical offices everywhere—Scranton, Wilkesbarre, Newcastle, Lancaster, and Reading, and all the hundreds of towns in which we operate. Therefore, we have arranged for this by having what we call general and local consultants in all the cities and towns including Philadelphia and Pittsburgh. These consultants, of course, work on a fee basis. Outside of Philadelphia and Pittsburgh we have about 1000 men who act as local consultants and general consultants, the general consultants being surgical men and the local consultants being medical men. These consultants plus the 50 people in the central office comprise our medical department.

The purpose of this entire medical force is, first, to handle accident cases, for with a force of 25,000 people we are bound to have accidents; and, second, to examine new employees.

The turnover among our women employees is about 30 or 35 per cent a year, largely during the first 6 months of service, and something like 10 or 12 per cent among the men. This turnover and the growth of business necessitates hiring new people who must be examined to make sure that we hire people who are not going to be untoward burdens upon us, that we are not going to introduce into the service any hazards by reason of physical inability to carry on, and in order to guard against the infiltration into service of people who may be general hazards, as they may have some communicable disease.

We are not seeking a force of supermen and superwomen in the telephone business. We have no notion that the principal purpose of our examination is to get one hundred per cent men and women. We hire a good many people who are 90, 80, and 75 per cent perfect, if that is the way to describe it. Sometimes it is required of people who are brought in under those conditions that they have impairments corrected before they are employed; but, again, the purpose of the examination is, as I first described, to guard against physical misfits. The medical department also investigates group conditions which seem doubtful.

To make diagnoses in individual cases, to recommend treatment, to encourage safety and health measures are factors of tremendous importance in which our medical people are doing valuable work. Our consultants assist physicians of our employees when called upon to do so, and they handle emergency cases when employees become ill at work.

Right here may I say that we share the doubt that seems to exist in general society as to how far industry should go in handling the medical affairs of its employees. We are trying to keep in the middle of the road. We are not attempting to run a medical dispensary, we are not attempting to treat employees and we do not do so except in certain emergencies. On the other hand, we are inclined to believe that possibly because the state continues to fail adequately to do its entire job in this respect we may some time be forced into extending the scope of our medical work. That time has not come, however, and so today we are conducting through these medical offices what we are disposed to term diagnostic clinics, not medical dispensaries. May I emphasize that!

To gain some idea of what the medical forces do in a year, let us look at the statistics for last year. We examined last year at the medical offices 10,100 people (intake people who have come to us for work and, if they are able to pass medical examination, will presumably be employed) and the local consultants examined approximately 1,500 people, making a total of 11,600 examinations.

As to voluntary examinations, which we encourage but do not prescribe, something like 4,600 people last year accepted that opportunity to have medical examinations. Of these people who were examined when being employed or voluntarily as employees, something like 20,700 came again for examination.

The medical department handled about 1,000 minor accident cases. Major accidents are handled by the general consultants, the men who are called to the scene when an accident of consequence occurs.

As to minor illnesses, that is, an employee was ill but not sufficiently ill to go home—he might have been hoarse, he might have had a sore throat, or what not—the medical offices took care of 9,000 such cases last year.

There were 2,100 X-ray and fluoroscopic examinations last year. There were 6,800 telephone

consultations with private doctors. As we see it in the medical department telephone consultations are quite important, for we have a benefit plan which calls for payment of sickness benefits and we must follow sickness cases rather closely. It quite frequently develops, as a consequence of the medical department's examination of the records or papers in the case, that that department may seem called upon to consult with the employee's private physician; or in a case of sickness the employee may suggest to the private physician that he consult with our medical department, a medical officer or one of our examining physicians who is known by the employee to have a more or less complete medical history of the employee.

Personal consultations with employees and families also numbered about 6,800. For instance, Johnny Doe, a lineman, who has been with us only a short time, who makes perhaps only $35 or $40 a week, and who has several children, hasn't much saved and perhaps has no family doctor. He thinks something is wrong with one of his children and he comes to the medical office and says, "Will you look the kid over?" We make it perfectly clear to him that we will be delighted to look the child over, not with any idea of prescribing medicine or treatment, but rather to determine what is the cause of the disarrangement and suggesting to the employee a certain form of treatment that may be provided, of course, by a doctor of his own selection. This is an important element of the work which is tremendously appreciated by the employee.

And finally last year the medical department made 7,600 laboratory examinations, blood, sputum, urine, and so forth.

There are a number of important by-products as results from medical department work which we would have to have done by the employment of outside physicians if we did not have a medical department and medical offices. My particular job in the telephone business is that of service operations. Under my direction are a great many buildings, a great number of quarters in which people do everything but sleep; they eat, work, and play in these quarters. Once a year it is my job to call on the medical office to make inspection of such quarters with reference to light, ventilation, sanitation, and things of that sort; and the best performance of the best telephone engineer in the world will sometimes suffer at the hands of a medical officer who visits the building with the idea of "spotting" things which from the medical officer's point of view are not sound.

We examine each year (and more often as circumstances seem to dictate) all people who handle foods and the methods of food handling. We make surveys of any group which seems to have an untoward amount of absenteeism or if an epidemic threatens the group. The manager of the medical department told me recently of examinations of 325 employees in a particular group in which had been an uncommon amount of absenteeism. Of those 325 employees, 25 per cent were pronounced to rate 100 per cent physically; 72 per cent had correctible impairments of some sort, and 3 per cent had non-correctible impairments. These figures may not surprise you but they surprised me very much. However, he gave me this bit of additional advice that 3 months later 50 per cent of that 72 per cent who had correctible impairments had had those impairments corrected or were in the process of having them corrected.

I can recall a case within the year of an operating force working in a rather small town where there was threatened a serious outbreak of smallpox. I suppose the doctors were quite capable but they were overwhelmed with the volume of this thing, and it seemed wise to us to offer to help them with our medical people. Unless I am greatly mistaken, we went in for wholesale vaccinations and our services were made available to whatever extent they were sought by the medical men of the particular community.

Another function, and an important one, is what I have termed health and exercise urges and warnings. In a very large force such as that in Pittsburgh or Philadelphia, where it is fashionable not to wear too many clothes, to wear rather short skirts, to eschew rubbers, and to take the chances which women (and men, too) take, we have found it possible to correct the consequences of otherwise natural conduct on the part of people by warning them at given periods of the year that if they do not watch out, colds are going to get them, or sunburn, or poison ivy, or all manner of things, warnings which sound like a mother talking to a child, but which are effective if done in a common sense fashion without too much medical lingo. Urges for exercise are particularly effective as directed toward old fellows like myself, who are getting lazy and fat.

The cost of operation of this medical department last year was $158,000. That is about $6 per employee per year. I do not know whether it strikes you as being high or low, but I do believe we have rendered a real service, for a force such as we have in the Bell Telephone System of Pennsylvania—a force composed largely of women,

girls who are not of economic independence, girls who have to work for a living. Girls who come out of modest homes produce situations wherein, following sickness or operations, something must be done to make it possible for them to recuperate under favorable conditions, and one of the little conceits of our medical work is the operation of two rest homes, one in Philadelphia and one in Pittsburgh. Here, under non-professional direction but under professional supervision, quarters are provided, home quarters, in an establishment without nurses and without doctors, wherein 19 young ladies can be accommodated at Philadelphia and 24 at Pittsburgh, and where girls can go to take it easy and loaf, for the sum of $12 a week. And in that comfortable environment there is plenty to eat and plenty of rest and good, honest, motherly suggestion; so that they do not do anything but recuperate and this they do more quickly than in their sometimes modest, sometimes not even modest, homes. That work we think is of great importance, and to us it is tremendously satisfactory.

Last year, in the Pittsburgh Rest Home, the average use was about 16 people at all times, and in Philadelphia, about 13 people. The average stay of girls in those rest homes was 30 days in the Philadelphia home and 38 days in the Pittsburgh home. As I have told you, we charge them $12 a week there, which, of course, does not begin to cover the cost. To make it possible for them to pay that $12, we have, as I have said, a benefit plan under which we pay people for sickness absence, and I should say in 9 cases out of 10 the benefits we pay are more than ample to meet the rest home charges. The net cost of running those two homes last year was $25,000 in Philadelphia, and $37,000 in Pittsburgh.

We carry on an accident prevention campaign on a fairly large scale, for what the men, the employees, get out of it, and for what we know we get out of it. If I had time, I am quite sure I could interest you in describing how we arouse the impulse for safety in our employees and how we encourage the accumulation of knowledge of first aid practices and, more important, how effectively they put that knowledge to use in the course of their own employment and when they encounter accidents along the highways and elsewhere.

One or two figures I think will impress you. As a result of accident prevention work since 1915 we have cut our accidents down—accidents of all sorts—from 21 per 100 employees a year, to 10 per 100 employees a year; and lost time accidents in the same period, from 10 per 100 employees a year to one-third accident per 100 employees.

For the women, for whom we have no requirement for teaching first aid, we have health courses which are of tremendous interest. We are trying to interest these girls in good health. About 9,000 of our women have taken the health course on their own time. It is our purpose to tell them what a normal body is; what good nourishment is, something about foods, diets; something of habits of living, care of the teeth; prevention of disease; care of the sick; and some first aid; and the young women eat it up, young women who are looking ahead, I suppose, to the time when they are going to run their own households and have their own children, and incidentally want to preserve their good looks. It is fine for them and fine for us.

What we are trying to do by an evolutionary process, because we have not evolved our final product yet, is to make it fashionable to stay well, to work safely, to protect earning capacity, to serve efficiently, to take no chances in sickness and with impairments. All the Bell Telephone Companies are doing that. We think the telephone service is better by reason of it. We think that you gentlemen who pay for telephone service, therefore, profit by it. We believe that it is a useful contribution to your own profession. We think we are actually making a contribution and we think that it pays us.

DISCUSSION

R. V. Rickcord, New York; Director of Personnel and Statistics, Brooklyn Edison Company: Although not fully recognized, it is more or less a fact that an industry in a community knows more definitely how it is trying to develop its medical problem than do the physicians of that community. The reason for this is that every industry has a very definite problem which sooner or later it must solve. The size of the problem is large or small, depending upon how extensively the industry wishes to involve itself. A great industry, with, let us say 50,000 employees, affects a group, if you include the employees' families, of a quarter of a million individuals, or the equivalent of a good sized American city, with practically all the medical problems of such a city.

It also means that if such a group is contained within a city like that of New York, then, on an average, one out of every 30 individuals you see on the streets is either an employee of a concern of this size or a member of the family of such an employee; therefore one-thirtieth of all the medical service in the city, whether employed by the company or not, is used by this group. Those who feel that medical service in industry is not a major subject should certainly be convinced by these considerations.

The question is sometimes asked as to how and why industry became interested in medicine? The answer is that it could not help itself, it was forced to interest itself in the subject. It is a platitude that a great concern oils its machinery and to be logical it must pay corresponding attention to its human machinery. It is perhaps less platitudinous to state that the industry which does not furnish its employees with facilities for obtaining the best medical service, if it does not buy itself (meaning the industry) the best possible brains (if they are to be bought)

for this medical service, is in general maintaining an inefficient organization and is thus cheating itself.

By medical organization is meant, of course, one which is directly in contact with the particular industry concerned. As Mr. Staples has said, the objective of any well organized industrial organization is not to give clinical or bedside service. The physicians of this type of organization will under no circumstances replace or displace the employees' family physicians, but will instruct the employee to obtain medical treatment at the hands of his family physician and if it happens to be an industrial accident case, the industrial physicians will procure for the employee and the employer the finest medical and surgical treatment; they will furnish the family physician with historical information and all sorts of X-rays and biological analyses which they may have had to secure from time to time and will advise the employee regarding the use of hospitals and regarding surgical procedures; and they are willing to render such service because the employee's sick allowance is stopped if the consultant is sure that the employee is wasting the employer's time and money by refusing to take treatment. The consultants or company will even allow the employee's sick pay in order to enable the employee to pay the bills of the family physician. In other words, the aim of the medical organization is to stimulate, encourage, and urge the employee to take a great deal more medical treatment than he would ordinarily be willing to take without such stimulation.

It should be borne in mind that it is impossible to set up a halfway, or more or less neutral, medical organization in an industry. It is either bad, in which case the employee usually despises and distrusts it and will not use it unless compelled to do so, or it is a good institution, well organized with a full time physician at its head, in which case the service is so extensively used that the problem is to keep the number down to prevent a serious overloading, even with a stated modified service.

Two conditions stand out in securing the last named results, that is, as high a load factor as possible, as we call it. The first seems to be that the physician must treat each employee as though he were a private patient and give him courteous and effective consideration accordingly. The second seems to be that the humblest employee must be treated just as respectfully and considerately as though he were a general manager of the concern. I need hardly add that big industries in general heartily support and believe in the fundamental principles developed by Dr. Watson and put into force by such individuals as Mr. Staples. We believe that they are going a long way to make employees more willing and anxious to take medical service.

PROBLEMS OF SECURING BETTER CARE FOR THE SICK AND INJURED IN INDUSTRY[1]

ARTHUR E. HOAG, M.D., F.A.C.S., NEW YORK
Medical Director of the Standard Oil Company of New York

AT the request of Mr. Dooley, director of the personnel department of the Standard Oil Company of New York, I shall discuss today the problems of securing better care for the sick and injured in industry. This problem is not a new issue. It has confronted us in the past, still confronts us, and will continue to do so. I am here not with the idea of telling you of any completely successful solution or remedy but rather with the thought that it would afford me an opportunity to think with you about the situation.

I will not take up any of your valuable time discussing the care of the injured; this is covered by the workmen's compensation laws of the various states and is being kept under constant scrutiny by the employers, insurance companies, and the medical fraternity.

Industrial leaders of 20 years ago felt that the workmen's compensation law was revolutionary and that it would wreck industry. Today it would be difficult to find an industrial leader who is not convinced of its success. If the tremendous progress made in the past two decades is taken as a measure of possible developments in the next 20 years, we have no reason for undue pessimism as to the future.

Industry will continue to recognize its debt to the worker in order that it may continue to prosper, that the workman be contented, and that our social fabric be safeguarded. One of the outstanding problems of the day is that of caring for the sick employee and his family, but in this competitive era the employers' impulses of financial generosity must be somewhat limited.

Our company has used most of the methods with which you are familiar, namely: pensions, stock-savings plan, and death benefits; this amounts to a month's salary for each year of service, with an additional two months up to 10 years, at a cost of approximately 1 per cent to the company, and no cost to the employee. In addition the employees of the various plants have organized mutual benefit associations. In case of sickness this plan pays a man $15.00 to $18.00 a week for a period of 10 weeks at a cost to himself of 10 cents a week, plus an initiation fee of one dollar. Our records show, however, that the men do not fully participate; the figures vary all the way from 12 per cent to 90 per cent in the various plants.

The plants as well as the main office are provided with nurses during working hours. Physicians are on duty certain hours during the week, and are available at all times at their offices.

Our company has recently inaugurated a type of welfare service in which two people give a large part of their time to problems arising from sickness in the home and are subject to call at any time of day or night. They also handle legal, economic, or domestic problems arising in the life of any employee who wishes to avail himself of the services of these welfare workers. To illustrate this type of service in cases of illness: J. B. had a condition over a number of years which required an operation but hesitated, because of the cost, to consult a competent surgeon and was equally hesitant about going to a public hospital. (Our experience shows us that the vast majority of workers do not want charity. They prefer to feel that they are paying their way.) Our welfare workers, having the confidence of the man and a broad acquaintance with the various institutions and physicians, conferred with an able surgeon who agreed to operate for a sum which the man was able and glad to pay. The cost was satisfactory, the operation successful, and the man contented.

Another instance is that in which a clerical worker, suffering from a progressively failing eyesight and not well advised, sought to cope with the condition by frequent changes of eyeglasses. Our welfare workers conferring with him were convinced of the need of a complete medical examination. A blood test revealed the cause of the trouble. He responded to prompt treatment which we are convinced saved not only his eyesight but his mind as well.

Hundreds of similar cases could be cited where the plan has helped to save the pride and self-respect of the family, to save the patient needless worry and friction and delay through fitting the problem to the purse as far as possible, and to avoid for him the humiliation of sitting for hours in the public clinics. The cost of maintaining this service is more than outweighed, I believe, by the good will it has engendered.

I feel that the company has done all that can

[1] Presented in the Conference on Traumatic Surgery, before the Clinical Congress of the American College of Surgeons, Philadelphia, October 13-17, 1930.

be reasonably asked of it, and the employee himself should be made in some way to feel his responsibility in caring for himself and his family in the time of need.

Insurance companies are offering policies covering most of the hazards of industry, such as dismemberment policies, indemnity for special injuries, temporary disability, and accidental death. Statistics reveal that out of 6,000,000 workers, one-fourth only are covered by group insurance. Of this one-fourth, only 23 out of every 100 carry more than $1,000 of life insurance; the remainder carry sums as low as $250.

A help in solving this problem may be found in Dr. Dublin's book, *Health and Wealth*.

> The solution of the economic problem we have been discussing will come only when sickness insurance becomes as popular among working-men, and their families, as industrial life insurance is now. . . The cost of such insurance, if limited to cases of serious illness involving disability, will not be excessive. Non-disabling ailments, although of frequent occurrence, do not lend themselves to insurance coverage. The mechanics of handling enormous numbers of claims for petty amounts would add heavily to the cost of insurance and could, therefore, be of little advantage to the patients. It may be good practice in the early stages of this development to scale premiums down to cover only from two-thirds to three-quarters of the actual present cost of medical service in serious cases. The cost of such health insurance would be still further reduced and brought within the means of virtually all families if it could be written on large numbers of persons at one time (group or wholesale insurance). This is not the occasion, however, for a detailed outline of such a health insurance system.

Concerning insurance, however, a railroad man is quoted as saying:

> Our railroad has adopted the group insurance plan as a means of safeguarding the employees' future. The company bears the entire cost which averages about 1 per cent of the payroll. For this 1 per cent we show our constructive interest in the employee and beyond the employee in those dependent upon him. All corporations feel good will toward their employees, but the difficulty is adequately and justifiably to express this in some tangible way. We believe the payroll, expressed as 101 per cent, inclusive of group insurance, with the co-operation and good will it develops obtains much more value, dollar for dollar, for the railroad as a payroll expenditure than could be obtained by saving the extra 1 per cent. We have at work many measures for the protection of our employees, but we know of none that produces so much appreciation from the employees and their families as does the group life insurance.

I feel that some thought might be given to a plan whereby a workman would be taxed a certain percentage of his salary to meet partially the cost of sickness to himself or his family. The deficit might be carried by the employer. This co-operative plan would avoid the danger of too great paternalism and would allow the patient to continue under the care of his own physician, if he so desired. This plan might involve the establishment of a hospital or the endowment of a number of beds in an already existing hospital, as well as the group organization of doctors and of nurses who would work together for a predetermined fee. This would tend to do away with unnecessary laboratory work, prolonged treatments of doubtful value and would result in the employee returning to his work with considerable less loss of time.

While this plan may have unseen dangers and pitfalls, is it not better to see the need in advance rather than be forced to accept (as was industry years ago, the workmen's compensation law) a plan of state-controlled medical service?

THE IMMEDIATE TREATMENT OF INJURIES OF THE HAND[1]

SUMNER L. KOCH, M.D., F.A.C.S., CHICAGO
From the Department of Surgery, Northwestern University Medical School

THE first step in the immediate treatment of an injured hand is the determination of the extent of injury. Its necessity seems obvious, yet one frequently sees cases in which the failure to make a careful examination before operation leads to an incorrect or incomplete diagnosis, and, as a result, to an incomplete operation.

Two cases help to illustrate this point: A man sustained multiple small cuts of the volar surface of the right hand and wrist from flying pieces of glass. The cuts appeared to be superficial, and a hasty examination revealed no evidence of nerve or tendon injury. A week after the injury the patient first became aware of the fact that he could not flex the thumb at the interphalangeal joint. Careful examination of the hand, with the proximal phalanx of the thumb steadied between two fingers, showed that the power of flexion of the distal phalanx upon the proximal phalanx was lost, due to a division of the flexor pollicis longus near the wrist joint.

A second patient sustained a glass cut across the volar surface of the right wrist in an automobile accident. A number of the flexor tendons were divided and sutured immediately after the accident. Examination two weeks later (Fig. 1) showed complete anæsthesia of the palm, which he stated had been present since the operation. The surgeon who had cared for him wrote that the median and ulnar nerves were uninjured "because at the close of the operation the patient was able to flex all his fingers."

In addition to the fact that it is wellnigh impossible to divide the flexor tendons of the fingers near the wrist without dividing the median nerve and without injuring the ulnar nerve is the less obvious and often forgotten fact that an individual with the long flexor tendons intact can close the fingers and thumb even if both median and ulnar nerves are divided at the wrist, for the nerve supply of the long flexor muscles enters the muscles high in the forearm.

We wish first to discuss briefly the examination of the hand for injuries of the nerves, injuries of the tendons, and injuries of the bones. They are mentioned in this order because it is both the order of importance, and the order of the frequency with which injuries of the deeper structures are overlooked.

Nerve injury. The median and ulnar nerves are mixed nerves; the radial nerve below the middle of the forearm is entirely sensory. Two minutes' examination of the hand for sensory loss is sufficient to indicate definitely the presence or absence of nerve injury (Fig. 2). The essential evidence of loss of motor function due to nerve injury can be elicited quite as easily. The ulnar nerve controls the movements of adduction and abduction of the fingers toward and away from the middle finger, and adduction of the thumb to the hand (Fig. 3). Both ulnar and median

Fig. 1. Appearance of hand 2 weeks after division of flexor tendons and of median and ulnar nerves at the wrist. Because of low grade infection it was necessary to postpone suture of the nerves, whose division had not been recognized for a number of weeks.

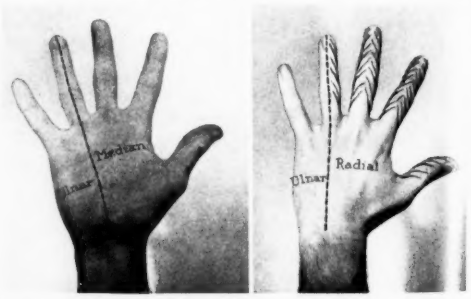
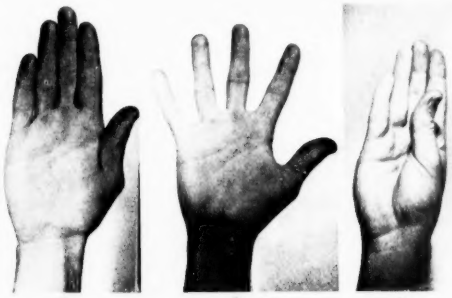


Fig. 2. The sensory distribution of the median, ulnar, and radial nerves in the hand. Absence of the tactile and pain sense in any of these areas indicates that there has been a crushing, tearing, or division of the nerve supplying the affected area.

[1] Presented in the Symposium on Traumatic Surgery, before the Clinical Congress of the American College of Surgeons, Philadelphia, October 17, 1910.



A B C

Fig. 3. Adduction of the fingers toward the middle finger, A; abduction of the fingers from the middle finger, B; and adduction of the thumb toward the hand, C; are carried out by the interossei, the muscles of the hypothenar eminence and the adductor pollicis, all of which are supplied by the ulnar nerve.

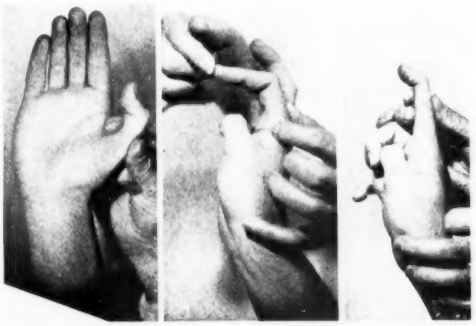
A B C

Fig. 4. A, Flexion at the metacarpophalangeal joints is produced by the lumbricals and interossei. B, C, With injury or division of the median and ulnar nerves below the middle of the forearm the power of flexion at the metacarpophalangeal joints is lost; the fingers can still be flexed at the interphalangeal joints by the long flexor tendons.

nerves help to produce flexion at the metacarpophalangeal joints (Fig. 4 A) by reason of their control of the lumbrical and interosseus muscles. Even if these nerves are injured below the middle of the forearm the fingers can be flexed at the interphalangeal joints, but there is loss of flexion at the metacarpophalangeal joints due to loss of lumbrical and interosseus action (Fig. 4 B). If the radial nerve is injured in the arm or upper forearm, there is loss of sensation in the area of radial nerve distribution and the characteristic wrist drop of radial or musculospiral injury is present (Fig. 6 A).

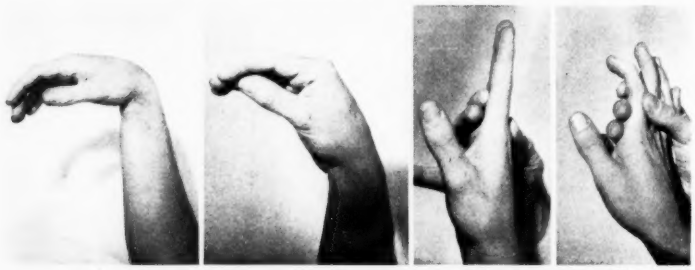
Tendon injury. The tendons most frequently injured are the long flexors and long extensors; and since their injury brings about such marked impairment of function it is particularly important not to overlook it. Division of the tendon of the flexor pollicis longus can be recognized easily if the proximal phalanx of the thumb is held fixed. If the tendon is intact, the thumb can be flexed at the interphalangeal joint (Fig. 5 A); if it is divided, the thumb remains in extension and no movement is possible. Division in the hand or fingers of the flexor digitorum sublimis alone is somewhat difficult to recognize before operation, for the intact flexor profundus, by reason of its attachment to the distal phalanx, can produce flexion at both interphalangeal joints. Division of the profundus alone can be recognized readily by the inability to flex the finger at the distal interphalangeal joint (Fig. 5 B). If both superficial and deep flexors are divided the patient cannot flex the fingers at either of the interphalangeal joints.

Division of the extensor tendons on the dorsum of the hand results in an inability to extend the fingers (Fig. 6 B). It must be remembered, however, that if the proximal phalanges are fixed the patient can extend the fingers at the interphalangeal joints with the aid of the lumbricals and interossei (Fig. 6 C), even though the extensor tendons have been divided on the back of the hand. Figure 6 D shows the characteristic position of the finger, with inability to extend the finger at the distal interphalangeal joint, because of rupture of the extensor tendon opposite the distal joint or avulsion of the tendon from its insertion at the base of the distal phalanx. Mason recently reported a group of such cases and



A B C

Fig. 5. A, If the proximal phalanx of the thumb is fixed active flexion at the interphalangeal joint is due solely to the action of the flexor pollicis longus. If the muscle or tendon is injured or divided flexion is limited or the thumb remains fixed in extension. B, Position of the finger after division of the flexor profundus; active flexion at the proximal interphalangeal joint is produced by the flexor sublimis, but the finger remains extended at the distal interphalangeal joint. C, If the flexor profundus is intact the finger can be flexed at the distal interphalangeal joint.



A B C D

Fig. 6. A, "Drop wrist" of musculospiral or radial nerve injury. B, Loss of power of extension of the fingers due to injury or division of the extensor communis digitorum. C, With the proximal phalanges fixed or supported the fingers can be extended by the action of the lumbricals and interossei even though the extensor communis is divided. D, Loss of power of extension at the distal interphalangeal joint due to division of the extensor tendon opposite the joint or avulsion of the tendon from its insertion on the distal phalanx.

showed that the exact nature of such injuries is frequently overlooked until the patient, some time after the injury, calls the attention of the surgeon to the loss of power of extension at the distal joint.

Bone injury. Bone injuries are least likely of all deep injuries to be overlooked, for today the layman is likely to request an X-ray examination if it is not forthcoming. One should remember, however, that simple anteroposterior and lateral views of the wrist mislead even expert roentgenologists into making a diagnosis of "no evidence of bone injury or displacement." The only satisfactory roentgenograms of the carpus are stereoscopic films, and the failure to recognize a fractured navicular or a dislocated semilunar is usually due to the failure to make stereoscopic films.

THE TREATMENT OF HAND INJURIES

Having determined the extent of injury the next consideration is its treatment. I wish to mention first the preparation of the hand for operation and to speak briefly of the treatment of five groups of cases.

Many methods have been suggested in the preoperative preparation of the affected area in patients with compound injuries. Without wishing to make dogmatic statements or to take issue with those who prefer different methods I would like to describe the method which we have used on our service and which we believe has proved of value.

With the patient lying on the examining table the injured hand is laid on an arm board covered with a sterile towel. If the wound is oozing or bleeding profusely gentle pressure is maintained over the wound with sterile gauze held with sterile hæmostats or a sterile gloved hand. The area about the wound and for some distance from it is shaved, and cleansed as carefully as possible with green soap and warm sterile water. If grease and dirt cannot be removed with soap and water

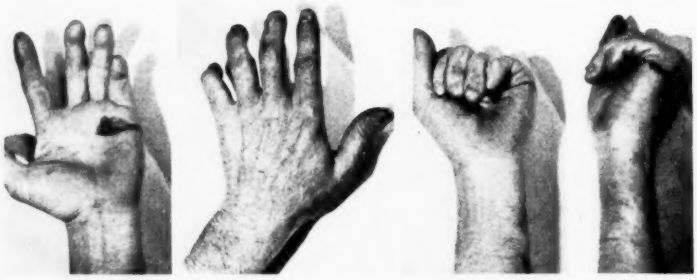


Fig. 7. Functional result in a patient with considerable loss of skin and subcutaneous tissue of the third, fourth and fifth fingers and fractures of the proximal phalanges of the fourth and fifth fingers.

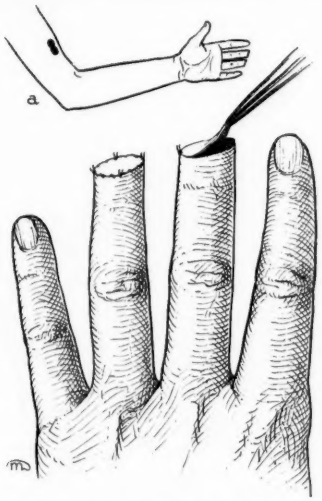


Fig. 8. Technique of application of a free full thickness graft to the tip of a finger.

benzine or some other fat solvent is used, and followed again with soap and water. With the area about the wound cleansed the gauze dressing is removed from the surface of the wound, and any loose particles or débris are removed from the wound itself. The wound is then irrigated with sterile soapy water and, if extensive and badly contaminated, scrubbed gently with sterile gauze "sponge sticks." Wounds and raw surfaces are not irrigated with tincture of iodine or other antiseptic solutions, since we believe that the harmful effect of strong chemical solutions on delicate and fragile tissue is greater than their potentially helpful effect as sterilizing agents.

Fig. 9. Result of the application of a free full thickness graft to the lateral surface of the index finger after a punch press injury. There was a clean cut wound with loss of the skin and subcutaneous tissue over the entire radial surface of the distal phalanx. The distal interphalangeal joint surfaces and the bare flexor tendon were exposed. Healing took place by a primary union with complete retention of function of the index finger.

That antiseptic agents often stain tissues and make their recognition more difficult is of less importance, but worthy of consideration.

If, as rarely happens in cases of hand injury, the wound is one in which complete débridement and primary or secondary closure are possible no cleansing of the wound itself is performed. Just before operation the skin edges immediately about the wound are painted with 5 per cent picric acid in 50 per cent alcohol or with tincture of iodine, and débridement is performed, with the result that the contaminated wound is converted into a clean wound. In only an occasional case of hand injury, however, is complete débridement possible, since structures essential to the function of the hand lie close to its surface.

Superficial injuries. The first group of cases requiring immediate treatment includes those with injury and loss of skin and subcutaneous

A B C D E

Fig. 10. A, B. Position of fingers before operation. C, D, E. Functional result 18 months after suture of the median nerve and the flexor tendons of the middle, ring, and little fingers at the wrist.

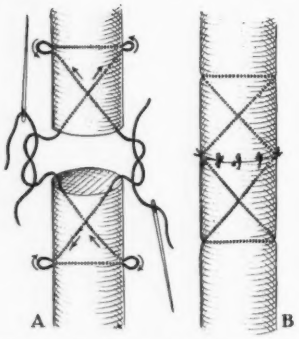


Fig. 11. Technique of tendon suture.

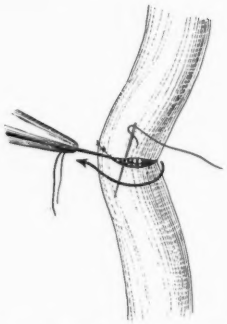


Fig. 12. Technique of nerve suture.

tissue. In some of these, particularly the cases due to crushing injuries, it is only possible to excise the obviously necrotic tissue and hope that remaining tissue, which looks viable when first seen, has not been hopelessly injured. In others, however, in which there has been a clean cutting injury or an avulsion of covering skin it may be possible, as Lyle and Garlock have emphasized, to lay skin grafts over the raw surface immediately and thus hasten healing and avoid the sacrifice of one or more fingers. The following is a case in point:

A carpenter, 51 years of age, sustained a crushing injury of the third, fourth, and fifth fingers of the left hand with fractures of the proximal phalanges of the fourth and fifth fingers, with exposure and some laceration of the flexor tendons, and with a considerable loss of skin, particularly over the volar surface of the middle finger. Instead of amputation of the affected fingers, as was suggested by the surgeon who first saw the patient, débridement was carried out, suture performed where the skin edges could be approximated, and a free full thickness graft of skin from the left thigh sutured over the raw surface on the middle finger. In spite of some infection and partial loss of the graft healing took place in 4 weeks' time, and with the aid of physical therapy, begun while the raw surfaces were still granulating, a good functional result was obtained (Fig. 7).

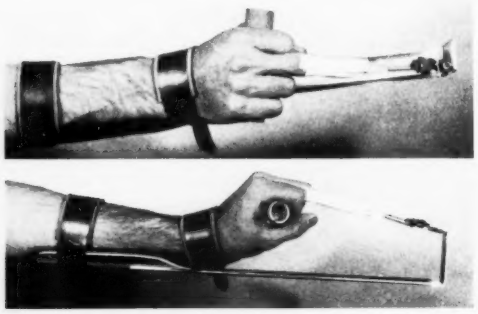
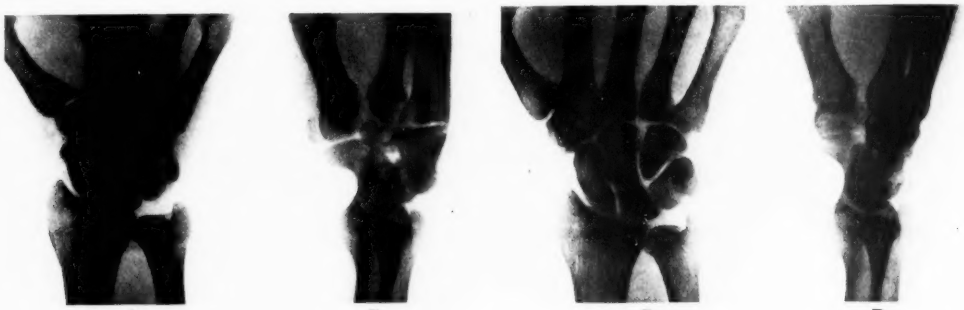


Fig. 13. Splint for maintaining traction on one or two fingers while permitting movement of the uninvolved fingers and maintenance of the wrist and thumb in the position of function.

In cases in which the tip of a finger has been lost and which are seen within a few hours after injury it is possible to lay a free full thickness graft from the arm or thigh over the raw surface and by maintaining pressure over it until healing is complete to secure a very satisfactory result (Figs. 7, 8). In nine such cases seen shortly after injury this procedure was successfully carried out. Amputation at a higher level was avoided and the power of flexion at the distal joint was preserved.

Tendon injuries. The second group of cases is that in which tendon injury has occurred. A number of factors are of particular importance in determining the immediate treatment: the conditions under which the injury has been sustained, the first aid treatment rendered, the time that has elapsed since the injury, the exact location of the injury, and, finally the facilities available for its repair. If a tendon injury is the result of a clean cutting wound,—from a glass, or broken bottle, or a porcelain water faucet, sustained indoors,—and if the patient's hands are clean, there is a reasonable chance that the wound is not infected. This possibility becomes less when the patient's hands are soiled, or covered with dirt and grease, or when the injury is sustained out of doors—from flying glass, broken windshields, etc. The first aid treatment is of importance. If considerable bleeding occurs bystanders become alarmed and possibly contaminate the wound in their anxiety to control the hæmorrhage. The time element is of importance. If the injured hand is seen immediately, there is no chance for



A B C D

Fig. 14. Crushing compound injury with multiple fractures and dislocations of the carpal bones. A, B. Before operation. C, D. After operation.

Fig. 15. Functional result of case pictured in Figure 14, four months after operation.

bacterial growth to take place. If several hours have elapsed such an opportunity is given, and if more than 4 hours have elapsed, we believe it is unwise to attempt primary operative repair. The exact location of the injury is of importance. Tendons which are surrounded by definite sheaths are more vulnerable than those which are surrounded simply by areolar tissue. Any infection introduced into an open tendon sheath spreads readily from one end of the space to the other and very quickly involves its entire extent. If no sheath is present localization of the infection is favored and widespread diffusion of an infectious process is less likely to take place. Finally, it seems unnecessary to say that tendon suture is a major operation, and one that should not be attempted except in a well equipped operating room; yet one frequently sees cases in which a tendon repair has been attempted in a poorly equipped doctor's office or a hospital emergency room with results that are far from ideal and difficult to counteract.

It is our belief that an immediate repair of divided tendons is justifiable if the wound is a clean cutting wound, made by sharp instruments, if the wounded hand is clean, if the cut is sustained indoors, if the first aid dressing has been sterile, if the patient is seen within a few hours of the time of injury, and if a well equipped operating room is available for surgical treatment. If these conditions are not present we believe it is wiser to close the superficial wound loosely with a few interrupted sutures and permit healing to occur before attempting a repair of the injured tendons. We are particularly conservative about attempting immediate suture of tendons surrounded by a sheath. We have on several occasions seen cases in which the suture of tendons on the back of the hand has been followed by a slight localized infection without serious impair-

ment of the operative result, but we can recall but one case in which a low grade infection developed after suture of flexor tendons without impairment of the final result. In the majority of such cases which have come to our attention there has been extensive spreading of infection with eventual necrosis and sloughing of tendons, and in some cases sloughing of superficial tissues and ankylosis of joints as well—conditions which make it necessary to postpone any attempt at operative repair for long periods of time, and often make operative restoration almost impossible to accomplish. What can be accomplished in similar cases by delayed repair is illustrated in the following case:

This patient sustained a glass cut of the right wrist in July, 1927. Because there was some doubt as to the presence of a clean wound the skin was loosely sutured and the wound permitted to heal. Late in August, the wound was explored, and the divided flexor tendons to the middle, ring, and little fingers and the divided median nerve were sutured. With the help of physical therapy this patient secured an excellent functional result (Fig. 9) with complete return of sensation in the median nerve area at the end of 18 months.

Nerve injuries. The third group of cases includes those with injury of the median or ulnar nerves. If one or both of these nerves have been divided, without injury of the tendons, one is justified in performing an immediate suture in certain cases in which with extensive tendon injury immediate operation would not be justified. We say this for two reasons—first because divided nerves do not retract as divided tendons do, and an extensive dissection to expose them is rarely necessary; and secondly, because the results of immediate nerve suture, particularly as regards the return of motor function, are so much better than the results of delayed suture that one is justified in taking a somewhat greater chance in order to secure an immediate end-to-end apposition.

If either tendons or nerves are sutured they should, if possible, be united by end-to-end suture (Figs. 11, 12). With nerves we believe no other type of suture is of value. In tendons only, a silk suture may be passed through the tendon substance. Very fine interrupted silk sutures, threaded on very fine needles, help to secure accurate end-to-end apposition. In nerve suture one must rely for apposition on this single row of fine silk sutures passing through the nerve sheath only (Fig. 12).

Bone and joint injuries. The fourth group of cases includes those with injuries of the bones and joints. The principles of treatment do not differ from those involving injuries of bones and joints in other parts of the body. If one or two metacarpals are involved, or the bones of one or two fingers, it is important to provide some form of splint which does not immobilize the entire hand (Fig. 13), in order that stiffness and limitation of movement due to immobilization of the fractured bones may be kept at a minimum.

What may be accomplished in compound injuries, with extensive injury of bones and joints of the hand, is illustrated by the following case:

The patient, a man of 28 years, sustained a crushing injury of the right hand with bursting of the skin on the palm and dorsum of the hand and with multiple fractures and dislocations of the carpal bones (Fig. 14A and B). He was seen by Dr. Michael L. Mason 5 hours after the injury. No evidence of nerve or tendon injury was found. The superficial wound was cleansed and débrided, the bones brought into place as well as possible and the superficial wounds sutured. The hand was immobilized in the position of function for 7 days. The wounds healed by primary union. At the end of 7 days gentle movement of the fingers was begun; and at the end of 15 days active physical therapy. The patient returned to work 7 weeks after the injury. The functional result at the end of 4 months is shown in Figure 15.

Small penetrating wounds. The last group of cases in which the immediate treatment is of paramount importance includes those cases in which virulent organisms such as the organisms of gas gangrene, tetanus bacilli, the virulent organisms from human or animal mouths and virulent pyogenic organisms have been introduced deeply into the tissues.

The history of the injury, if it can be relied upon, the place in which it was sustained, the appearance and odor of the wound discharge, and the location of the injury are all of importance in helping one to determine the presence of serious infection. Penetrating wounds sustained out of doors, on dirt roads, about the farm, in the stockyards, in icehouses, etc., may easily be infected with virulent anaerobes or with tetanus bacilli. Jagged wounds on the dorsum of the hand, particularly if over the metacarpophalangeal or proximal interphalangeal joints are usually the result of fist fights, and infected with the organisms which abound in the mouth. A dirty brownish wound discharge or a thin bloody discharge with a foul odor suggests anaerobic infection; a fæcal odor suggests infection with the saprophytic and other organisms constantly present in the mouth.

Deep penetrating wounds of the type described and wounds resulting from bites or fist fights should never be sutured. If infection with bacillus welchii or other organisms of gas gangrene is suspected the wound should be laid widely open, necrotic tissue carefully removed, and

active treatment with Dakin's solution begun immediately. Anti-gas-gangrene serum should be given. Wounds resulting from bites or fist fights should be left widely open and massive warm wet dressings applied immediately. The hand should be watched carefully for signs of extension of infection. A dark field examination should be made as early as possible to rule out the possibility of a syphilitic infection.

The importance of giving tetanus antitoxin in every case in which infection with tetanus bacilli might occur needs no comment.

Penetrating needle and sliver wounds, and particularly wounds sustained during the course of a surgical operation, deserve special mention because they are not uncommon and because they often lead to serious and spreading infection. We know of no way in which such a wound tract may be disinfected. If virulent pyogenic organisms, such as hæmolytic streptococci, are carried deeply into the tissues by a needle or sliver we believe the best results will be secured by immobilizing the affected part, applying a massive warm wet dressing to the upper extremity and keeping the patient at rest in bed. Premature and ill-advised incisions in such cases invariably lead to disaster. We have seen four patients within the past few years, two of them physicians and one a dental surgeon, in whom ill-advised incisions led to rapid spread of the infection, generalized septicæmia, and death. We have seen a considerable number of other cases, more than one half from the medical and nursing profession, in whom early operation led to extensive spread of the infection, suppurative tenosynovitis, multiple joint infections, and long continued illness which eventually resulted in extensive, and in some cases total loss of function of the hand. We have come to believe, therefore, that the greatest safety lies in helping nature to build up a protective wall of leucocytes about the affected area and in maintaining the patient's resistance at the highest possible level. If definite evidence of localized infection develops the affected area should be drained, but one should be certain that such localization has taken place before making any incision for drainage.

SUMMARY

The points, then, which we consider of particular importance in the immediate treatment of injuries of the hand are: careful examination, first of all, to determine the nature and extent of injury; immediate covering of raw surfaces if it can be accomplished; careful discrimination as to which cases should have an immediate operative repair, which should be allowed to heal and be operated upon at a later date, and which should be treated as gravely infected wounds from the outset; and, finally, when surgical treatment is carried out, whether immediately or later, carefully executed surgical technique with adequate assistance in a clean and well equipped operating room.

REFERENCES

GARLOCK, JOHN H. The treatment of compound injuries of the extremities. Ann. Surg., 1928, lxxxvii, 321–354.

LYLE, HENRY H. M. Skin plastics in traumatic lesions of the hand and forearm. Ann. Surg., 1926, lxxxiii, 537–542.

MASON, M. L. Rupture of tendons of the hand, with a study of the extensor tendon insertions in the fingers. Surg., Gynec. & Obst., 1930, l, 611–624.

COMMITTEE AND DEPARTMENT REPORTS

DEPARTMENT OF CLINICAL RESEARCH

BOWMAN C. CROWELL, M.D., CHICAGO
Director of Clinical Research

THE activities of the Department of Clinical Research are carried on through its central office at College headquarters with the co-operation of the following committees:

1. Committee on Bone Sarcoma
2. Committee on the Treatment of Malignant Diseases
3. Committee on the Archives of Malignant Diseases
4. Committee on Fractures
5. Committee on Standardization of Clinical Laboratories
6. Board on Industrial Medicine and Traumatic Surgery

The departmental work connected with the functions of these committees has been carried on by a staff which consists of the director and three clerks.

Reports of the work of the committees will be presented by their respective chairmen, but I take this opportunity of summarizing the outstanding features of the year's work of the department, with a special report on two newly-added activities.

Our contributions in the field of cancer have been especially along three lines; through the Registry of Bone Sarcoma, the Committee on the Treatment of Malignant Diseases, and a special investigation.

The work of the Committee on Bone Sarcoma is the subject of a detailed report, but I wish to emphasize here the importance of the installation of a new method of cataloguing the cases by the visible index system. I wish also to express the appreciation of the College not only to the increasing number of surgeons who are registering their cases, but to the members of the committee who have given unstintingly of their time during the year in the examination of the records and who at their own expense came to a meeting of the committee in Chicago during September which lasted for 2 days and carried on a remarkable co-operative study of the material of the Registry.

The Committee on the Treatment of Malignant Diseases has continued its scientific investigations along lines previously reported. It has also been developing a uniform system of record blanks for cancer of all parts of the body, which it is hoped will receive universal adoption. The plan for supervision of the organization and administration of cancer clinics has been elaborated, and the interest of many hospitals, states, and provinces has been manifested. The plan as it was perfected has been published in the October, 1930, number of SURGERY, GYNECOLOGY AND OBSTETRICS.

The work of the Committee on the Archives of Malignant Diseases has been held more or less in abeyance during the year, awaiting the perfection of record blanks and a closer affiliation with the cancer clinics which will serve as a source of supply for the archives.

I refer to the reports of the chairmen of the Committee on Fractures and of the Board on Industrial Medicine and Traumatic Surgery for the details of their progressive work.

A special clinical research on the value of electrosurgery is the subject of a detailed report and a symposium which is being presented at the Congress.

I also draw your attention to the exhibition of the College's interest in the investigation of new forms of treatment of cancer, as manifest by the sending of a committee to start observations on the result of treatment obtained by Doctors Coffey and Humber.

The sectional meetings of the College have been attended by representatives of three of the scientific committees, and their participation has served the designed purpose of informing the Fellows of the work of the College and of eliciting their interested co-operation in the furnishing of material to the department for study. Their presentations at the meetings have been received with conspicuous enthusiasm and many written and verbal encomiums have reached the College concerning this program.

In our work on cancer the zealous and helpful co-operation of the American Society for the Control of Cancer merits very special recognition, and I suggest that the Director of Clinical Research be especially authorized by this Board to take appropriate official cognizance of their co-operation at the next meeting of the Board of Regents of that society.

COMMITTEE ON THE TREATMENT OF FRACTURES

CHARLES L. SCUDDER, M.D., F.A.C.S., BOSTON
Chairman

COMMITTEE

Charles L. Scudder, Boston, Chairman
John B. Walker, New York, Secretary
Nathaniel Allison, Chicago
A. P. C. Ashhurst, Philadelphia
Frederic W. Bancroft, New York
Willis C. Campbell, Memphis
Isidore Cohn, New Orleans
H. E. Conwell, Birmingham
Salvador Cordoba, Venezuela
Frederic J. Cotton, Boston
William Darrach, New York
Frank D. Dickson, Kansas City, Mo.
Eldrige L. Eliason, Philadelphia
William L. Estes, Bethlehem
William E. Gallie, Toronto
Fraser B. Gurd, Montreal
Donald Guthrie, Sayre
G. W. Hawley, Bridgeport
Melvin Henderson, Rochester, Minn.
Col. W. L. Keller, Washington, D. C.
Paul B. Magnuson, Chicago
Lloyd Noland, Birmingham
W. O'N. Sherman, Pittsburgh
Ernst A. Sommer, Portland
Kellogg Speed, Chicago
Frederick J. Tees, Montreal
Jorge del Toro, Porto Rico
John C. Wilson, Los Angeles
Philip D. Wilson, Boston

I HAVE the honor to present to the Board of Regents the seventh annual report of the Committee on the Treatment of Fractures. There are now 29 members of the Committee.

The Fracture Outline has been completed and is in the hands of the College for publication.

The regional committees, now numbering 24, form a part of the active machinery of the general fracture committee and are being extended to cover the whole country. In the cities where sectional meetings were held last Spring, Doctors Campbell and Magnuson represented the Committee and took steps to arrange for further regional groups. Reports have now come from nearly all regional groups, showing that they are actively engaged in furthering the sound treatment of fractures in their several localities.

Subcommittees. Eventually every member of our committee will be actively engaged in the investigation of certain phases of fracture treatment, and we hope eventually to publish the reports of these subcommittees in the official organ of the College, SURGERY, GYNECOLOGY AND OBSTETRICS, or in *The Bulletin.*

Doctors Estes and Keller of the subcommittee on the fluoroscope have made a careful survey and in their report have offered valuable suggestions. This report is now recommended to the College for publication.

The fracture movie asked for by the Regents is in completed scenario form. The Committee has had several meetings in Boston with the two representatives of the Eastman Teaching Films, Incorporated, and wishes to report at this time that progress is being made.

The "Outline of Fracture Organization," prepared by the subcommittee on fracture organization, the members of which are Doctors Magnuson, Noland, and P. D. Wilson, has been completed and is in the hands of the College for use. An important activity of our Committee is to help the hospitals to arrange the care of fractures in a satisfactory way so that responsibility may be placed on a few surgeons, that an opportunity be afforded of outlining a general policy of treatment, and that the ultimate results may be better. The major difficulty lies in the establishment of central responsibility for the treatment of fractures in the open hospital.

The annual Fracture Oration[1] at the Clinical Congress, suggested originally by Dr. Franklin H. Martin, our Director, is to be given this year by Dr. Dallas B. Phemister, of Chicago.

The scientific exhibit at the Detroit meeting of the American Medical Association was under the care of a committee consisting of Doctors Speed, Darrach, and Allison with a consulting or advisory group. This committee is now authorized to assist in the preparation of similar exhibits for annual meetings of the various State medical societies. This step should help to promote the sound treatment of fractures.

Undergraduate teaching is in the hands of a committee with Dr. Darrach as chairman. Dr. Darrach is president of the Association of

[1] This paper appears elsewhere in this issue.

American Medical Colleges. A communication was sent to the executive committee of this Association, during its recent meeting in Omaha, and it is hoped our letter will lead to further active co-operation.

Contacts have been made with The National Board of Medical Examiners. This Board is interested in including questions on fractures regularly in its examination of prospective candidates for licensure. It is felt by your Committee that thus a direct stimulus may be brought to bear in undergraduate medical schools to improve fracture instruction.

The American Railway Association whose membership includes some 250 chief surgeons and 14,000 other surgeons in the United States has formed a permanent Regional Fracture Committee. This committee is co-operating with your Committee to secure better treatment of fracture cases the result of railway accidents and in the railway shops.

The National Safety Councils of the United States are interested in preventing further accidents in shops and on the highways. We are helping them in the first aid fracture work.

The American Red Cross has asked us, through its chairman at Washington, to revise the part of *The Text Book* dealing with the first aid in the treatment of fractures. Copies of the manual will be given to each member of our Committee and we will make the revision as suggested.

The work of the Committee grows slowly but surely. We are finding deplorable conditions in the fracture situation, but we believe that by continuing our work along the educational lines mapped out, the results will be greatly improved.

Through its Committee on the Treatment of Fractures I believe that the influence of the American College of Surgeons to secure the better treatment of fractures is growing greater and greater not only throughout the United States and Canada but throughout the world.

COMMITTEE ON THE TREATMENT OF MALIGNANT DISEASES

ROBERT B. GREENOUGH, M.D., F.A.C.S., BOSTON
Chairman

COMMITTEE

Robert B. Greenough, Boston, Chairman
A. C. Broders, Rochester, Minn.
Curtis F. Burnam, Baltimore
George W. Crile, Cleveland
Bowman C. Crowell, Chicago
William Duane, Boston
Edwin C. Ernst, St. Louis
J. M. T. Finney, Baltimore
Burton J. Lee, New York
Frank W. Lynch, San Francisco
Robert T. Miller, Jr., Baltimore
H. A. Pancoast, Philadelphia
H. Gideon Wells, Chicago
Francis C. Wood, New York

I HAVE the honor to submit the following report of the Committee on the Treatment of Malignant Diseases.

A meeting of this Committee was held in Chicago in October, 1929, and at that meeting an Executive Committee was appointed consisting of Doctors Bowman C. Crowell, Burton J. Lee, Edwin C. Ernst, and A. C. Broders, together with the chairman. This Committee was appointed because of the great difficulty in obtaining well attended meetings of the whole Committee with its very scattered membership.

In accordance with the action of the Board of Regents in October, 1929, approving the plan for the organization and co-ordination of special cancer clinics in general hospitals, under the general supervision of the College of Surgeons, a program of activity was established. A statement of the general organization and method of operation of cancer clinics was prepared and has been published in SURGERY, GYNECOLOGY AND OBSTETRICS, October, 1930, and has also been distributed in reprint form.

At the sectional meetings of the College in 1929 and 1930, representatives of this Committee were given opportunity to describe the plan of organization of these clinics, and much interest was aroused upon this subject. The American Society for the Control of Cancer gave hearty support to this project.

For the meeting in Philadelphia in October, 1930, in addition to the Cancer Symposium which has been a feature of several recent meetings of the College, a morning was given to a Round Table Conference on cancer clinics, and a distinguished group of speakers was secured for both of these meetings to discuss the subject.

In the meantime the former work of the Committee in the collection of uniform data in regard to cases of cancer in different regions and the end-result of treatment has continued, although no further publication on this subject is possible at this moment.

THE BOARD ON INDUSTRIAL MEDICINE AND TRAUMATIC SURGERY

FREDERIC A. BESLEY, M.D., F.A.C.S., WAUKEGAN, ILLINOIS
Chairman

COMMITTEE

Frederic A. Besley, Waukegan, Illinois, Chairman
Bowman C. Crowell, Chicago, Secretary
John E. Bacon, Miami, Arizona
Samuel R. Cunningham, Oklahoma City
Donald Guthrie, Sayre
Lucian H. Landry, New Orleans
A. D. Lazenby, Baltimore
Charles F. Martin, Montreal
Charles H. Mayo, Rochester, Minn.
Thomas G. Orr, Kansas City, Mo.
W. O'Neill Sherman, Pittsburgh
Loyal A. Shoudy, Bethlehem
Ernst A. Sommer, Portland
Frederick J. Tees, Montreal
John B. Walker, New York

YOUR Board on Industrial Medicine and Traumatic Surgery was established four years ago, and it is gratifying to record that there is an ever-increasing and growing interest on the part of the Fellows of the College, and outside groups, in its size, its ambitions, and its activities.

At the meeting in Chicago a year ago, an entire day was devoted to a program on traumatic surgery and its allied relationships. This meeting was accorded a large attendance and it elicited keen interest. A report of the proceedings was published and widely distributed.

It will be recalled that three years ago the Director General, Dr. Franklin H. Martin, outlined a minimum standard for the qualifications of men whom the Board could consider capable of practicing efficient traumatic surgery. Through the well organized efforts of Dr. Bowman C. Crowell such a list was prepared and has grown to approximately ten thousand names and many of these have been approved by established State Committees. These names have not been made use of in any material way as yet and their practical utility cannot be estimated at this time.

Frequent requests are now being received for advice and instruction in the setting up of medical organizations that can function properly in large industries. Some of these requests have been partially complied with and Dr. Earl W. Williamson has co-operated with heads of large personnel departments in the establishment of efficient medical organizations and there is a growing tendency on the part of employers to accept medical men only who are approved by the College.

Recently we have been asked by the Director of Health of the state of West Virginia if we could supply a man to make a survey of the conditions that prevail in that state in relation to the care of the injured workers in mines and in industry. This is being considered at present and a conference has been arranged to take place this week at this meeting in Philadelphia.

Several states have made or are contemplating changes in their workmen's compensation laws and in this connection some of them have appointed committees of surgeons to advise with the legislators. These surgeons have appealed to the Board on Industrial Medicine and Traumatic Surgery for aid and advice, but up to the present time it is feared that we have been of little material service to them.

Mr. Walter Carr, in his contact with the lay public and men associated with large industry, has observed a live interest in our program for securing better care of the injured and he has been able to further this interest. The financial co-operation of this industrial group waits upon the formulation of a definite, practical plan and the beginning of organized effort for the bettering of the detrimental conditions in the field of industry reported by the Research Board of the College four years ago and later more in detail by Dr. Williamson and others.

It would be unfair not to comment on the present efficient co-operation on the part of Dr. MacEachern. He has succeeded in securing far better facilities and equipment in hospitals for the care of these cases. The value of this is obvious.

On Friday of this week we are to present, at a full day meeting, discussions on traumatic surgery and its relationship.

If the work of this Board on Industrial Medicine and Traumatic Surgery is to comply with and to cope with the needs and exigencies of the situation relative to the securing of better and more efficient care for traumatic cases, treatment that is comparable to that which now prevails in surgery of election, then its scope must be extended and broadened. To this end may we make the following recommendations:

1. That the College employ a full time man, preferably a man of considerable surgical experience and with administrative ability, whose duty it shall be to build a department that shall equal in importance and efficiency the Department of Hospital Standardization. This is possible.

2. That the great influence of the College be utilized to standardize the teaching of traumatic surgery in medical schools, which instruction at the present time is, in most instances, deplorably weak, inadequate, and ineffective.

3. That a closer relationship be perfected between this department and the other departments of the College, for the purpose of greater efficiency and the avoidance of reduplication of effort.

4. That arrangements be made for more complete educational programs on the subject of traumatic surgery to be presented at each sectional meeting. These programs should be both scientific and educational for the laity for the purpose of creating a better public relationship and understanding of the situation.

5. That there be established a close working contact with large industries to the end that better correlated and more systematic medical organizations may be perfected and standardized.

6. That there be adopted some plan for cooperating with the officers of the American Automobile Association to secure better care for patients who are injured on the highways. In this connection there is a well recognized economic problem which vitally concerns the hospitals and the surgeons, and it is deserving of careful research.

7. That the public relationship department under Mr. Carr be encouraged to present our program to the leaders in large industries. It is not necessary to state that this can be accomplished by an appeal to them on the financial basis and from the standpoint of effecting a radical saving in human wastage. It is our conviction that financial aid and support can be secured from these sources to promote the activities of this Board, if this seems desirable.

8. That it would seem the part of wisdom to attempt to secure uniform workmen's compensation laws.

The field of endeavor undertaken by the Board on Industrial Medicine and Traumatic Surgery presents vast potential possibilities for constructive accomplishment by the College and the opportunity that this situation offers is not a privilege, it is an obligation.

REGISTRY OF BONE SARCOMA

BOWMAN C. CROWELL, M.D., CHICAGO
Registrar

COMMITTEE

Dallas B. Phemister, Chicago, Chairman
Bowman C. Crowell, Chicago, Registrar
Edwin I. Bartlett, San Francisco
Joseph C. Bloodgood, Baltimore
Barney Brooks, Nashville
Ernest Amory Codman, Boston
Charles L. Connor, San Francisco
James Ewing, New York
W. R. Galbreath, Porto Rico
Frank W. Hartman, Detroit
Henry W. Meyerding, Rochester, Minn.
John J. Morton, Rochester, N. Y.
Luis Razetti, Venezuela
Channing C. Simmons, Boston

DURING the year two meetings of the committee were held, one on May 17 in Philadelphia, and the other on September 27 and 28 in Chicago. The first meeting was devoted chiefly to a report of the registrar of the committee on the Registry at that date and a discussion of procedures recommended for the guidance of the registrar. At the Chicago meeting 9 members of the committee devoted 2 entire days to a study of the material in the Registry and a presentation of selected groups of cases. The chairman, Dr. Dallas B. Phemister, presented a group of cases which belong in the category of chondrosarcomata, which he has described as an entity with some characteristics differing from those of the ordinary osteogenic sarcoma. His discussion and case reports are published in SURGERY, GYNECOLOGY AND OBSTETRICS, January, 1930. From a study of the registered bone tumors about the shoulder joint, Dr. Ernest Amory Codman has isolated a group of 9 cases in the upper end of the humerus which he is describing as chondromatous epiphyseal giant cell tumors. In a survey of the Registry material one case of a tumor of the head of the tibia and one of the trochanter of the femur have been found which also correspond to this lesion. Dr. John J. Morton presented a group of registered tumors of the ribs, and Dr. Channing C. Simmons a group of tumors which had been diagnosed as giant cell tumors and which had developed a malignant phase. His conclusion was that this finding in no way conflicts with the conception of the benign nature of the true giant cell tumor. Dr. Barney Brooks presented an interesting miscellaneous group of cases for discussion. The question of revision of the nomenclature of bone tumors received serious attention but the committee was unable to agree upon any appreciable modification of that previously adopted and at present in use.

There are at present 1,158 registered cases, 162 of which have been registered since the last report. A considerable additional number have been submitted to the Registry and studied but were not considered suitable for registration. On 495 of the cases which have been circulated during the year, 861 opinions have been rendered by 20 doctors. It speaks well for the co-operation of the registering surgeons and pathologists that in only 82 of the 1,158 cases has it been impossible to trace the patient to know the end-result. Appended to this report is a classification of the cases at present in the Registry.

In 1925 Dr. Codman reported 13 accepted 5 year cures of cases of osteogenic sarcoma. In one of these cases death occurred 11 years after treatment. The Registry now contains the records of 51 cases in a total of 312 cases of osteogenic sarcoma living 5 years or more following treatment; that is to say, the Committee unanimously agrees upon these 51 cases as being osteogenic sarcoma which gives a ratio of approximately 16 per cent of those which were treated 5 years or more ago. In addition to this there are 21 cases in which the result is unknown. The longest period that any of these patients has survived is 21 years, there being 13 of these in which the patient has lived 10 years or more following treatment.

As regards Ewing's sarcoma, of which the Registry contains 129 cases, 72 were treated 5 years or more ago and of these the Committee accepts 11 cases as undoubted Ewing's sarcoma which have survived the 5 year period, the longest being for a period of 10 years. This gives a ratio of 5 year cures in Ewing's sarcoma of 15.3 per cent.

A more detailed report of all cases which have been accepted as 5 year cures will be published at an early date in SURGERY, GYNECOLOGY AND OBSTETRICS, the official organ of the College.

During the year a new method of indexing and recording the cases has been introduced which will greatly facilitate the future studies of Registry material.

The Committee emphasized the necessity of obtaining gross specimens of tumors in order to make the work of the Registry more successful.

There have been exhibits on the subject of Bone Sarcoma at several sectional meetings and talks on the subject by the Registrar at scientific meetings.

The present cases in the Registry fall under the following headings:

Osteogenic sarcoma		533
Of the femur	242	
Other than the femur	291	
Ewing's sarcoma		129
Myeloma		31
Inflammation		61
Periosteal fibrosarcoma		21
Metastatic tumor		34
Vessel tumor		17
Angioma	8	
Angioendothelioma	9	
Benign giant cell tumor		233
Giant cell tumor—malignant and variant		10
Benign osteogenic tumor		29
Unclassified and miscellaneous		43
Lymphosarcoma		3
Not bone tumors		14
Total		1,158

STATE AND PROVINCIAL SECTIONAL MEETINGS

NO essential change was made in the character of the sectional meetings during 1930 from those features which were introduced into the meetings in 1929. A great interest in the meetings was manifest by the large attendance and active participation of the Fellows of the College in the meetings.

Representatives of the scientific committees of the Department of Clinical Research attended all meetings under authorization of the Board of Regents. In addition to presenting the work of their respective committees to the Fellows of the College, these representatives formed local subcommittees to function in association with the Central Committees. In the intervals between the formal sectional meetings, the groups of visiting officials visited other cities where they presented programs before the local county medical societies, visited the medical institutions, and also formed local subcommittees. The work of the College on fractures, cancer, and bone sarcoma thus received an additional impetus and increased its usefulness.

One feature of great value and of great interest was the presentation of a number of talking medical motion pictures which were shown at all of the meetings through the courtesy and co-operation of the Electrical Research Products Company, Incorporated.

The hospital program included practical demonstrations and discussions in the hospitals, where local and general problems were discussed to the advantage and interest of all. A notable and pleasing feature of these meetings was a

larger attendance of hospital trustees and their active participation in the program.

The following sectional meetings have been held in 1930:

Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, Vermont—Worcester, January 6–7
Virginia, West Virginia, Maryland, District of Columbia—Richmond, January 9–10
Alabama, Florida, Georgia, Louisiana, Mississippi—Atlanta, January 13–14
Texas, Oklahoma, New Mexico—San Antonio, January 20–21
Colorado, Idaho, Utah, Wyoming—Denver, January 27–28
Iowa, South Dakota—Des Moines, January 30–31
Nebraska—Omaha, February 3–4
Nova Scotia, Prince Edward Island—Halifax, June 13
New Brunswick—St. John, June 16

The visiting speakers at these meetings included: Drs. Willis C. Campbell, Memphis; George W. Crile, Cleveland; Bowman C. Crowell, Chicago; Samuel R. Cunningham, Oklahoma City; Robert B. Greenough, Boston; Seale Harris, Birmingham; Philip H. Kreuscher, Chicago; Burton J. Lee, New York; Malcolm T. MacEachern, Chicago; Paul B. Magnuson, Chicago; Franklin H. Martin, Chicago; C. Jeff Miller, New Orleans; W. A. O'Brien, Minneapolis; Alton Ochsner, New Orleans; John Osborn Polak, Brooklyn; Messrs. Robert Jolly, Houston, and Herbert L. Willett, Jr., Washington.

REPORT ON THE WORK OF THE CREDENTIALS COMMITTEES

ALLEN B. KANAVEL, M.D., F.A.C.S., CHICAGO

ALL candidates for Fellowship in the American College of Surgeons must go through four stages before final acceptance. First, they must make formal application and be passed on favorably by the State or Provincial Committee. Second, candidates thus approved are requested to furnish the Committee on History Reviews with fifty case records of major surgical operations which they have performed and fifty abstracts of cases at which they have assisted, and these records are then individually examined by the Committee on History Reviews. The report of this Committee, together with all information pertaining to candidates, is then submitted to the Central Committee, and this Committee in turn makes recommendation to the Board of Regents who give the final approval.

The second stage of this procedure, particularly, places heavy demands upon the time of the committee in charge. The Board of Regents wishes to express its appreciation of the unselfish manner in which members of the Committee on History Reviews have sacrificed many of their leisure and working hours that the examination of records might be done with the utmost thoroughness. From May 27 to October 7 of this year twenty meetings demanded the time of these men; and, in addition, many of them devoted frequent afternoons and evenings to the scrutiny of histories.

When one considers that 608 sets of histories were examined and that each set contained 100 case records (60,800 in all), the magnitude of the Committee's task can be better realized. Nor is the presentation of case records a mere paper examination. Each case is carefully reviewed in order to ascertain whether or not the candidate makes a careful pre-operative study, whether or not his technique is acceptable among modern authorities, and whether or not the end-results obtained by him are satisfactory.

The meticulous care with which the Committee on History Reviews passes on case records is evidenced by the fact that 497 sets of histories were accepted and 111, or 22 per cent, were rejected. It should be added that this number were refused notwithstanding the fact that they were given an opportunity to send in additional records when the examination revealed any about which there was question. It is noted that even after being recommended by the various State and Provincial Committees, slightly more than one-fifth of all such approved candidates were not recommended by the Committee on History Reviews, which is added proof of the sincere desire of the Committee to have none but the best qualified surgeons members of the American College of Surgeons.

The total number of applicants to be admitted to Fellowship in 1930, on the basis of histories, is 493.

At all sessions of the Committee on History Reviews, Dr. Bowman C. Crowell, Associate Director of the College and Director of Clinical Research, and Mrs. M. T. Farrow, Executive Secretary, were present to assist the Committee in every possible way.

Again the members of the Board of Regents commend the excellence of the work done by the Committee on History Reviews and voice their thanks in appreciation of this unwearying service in behalf of the College.

The members of the Committee, all of whom are in active surgical practice and are associated with the local medical colleges, are as follows:

James H. Bloomfield
Dwight Freeman Clark
Harry Culver
William C. Danforth
Frank E. David
Joseph S. Eisenstaedt
Gilbert Fitz-Patrick
Robert H. Herbst
Harry Jackson
Oscar H. Kraft
Philip H. Kreuscher
Golder L. McWhorter
George J. Musgrave
Oscar E. Nadeau
Rudolph J. E. Oden
Charles H. Parkes
Charles H. Phifer
George W. Post, Jr.
Guy S. Van Alstyne
Charles B. Younger

BOARD ON MEDICAL MOTION PICTURE FILMS

SINCE the inception of plans for developing the production and use of motion picture films for teaching medicine and surgery the American College of Surgeons and the Eastman Kodak Company (through its subsidiary, the Eastman Teaching Films, Inc.) have been co-operating in the making of new films. A very comprehensive general program has been outlined which provides for the production of films on practically every subject pertaining to medicine.

Thirteen such films, completed and approved by the College, are now available to the medical profession. With one or two exceptions they are made in both the 35 and 16 millimeter size, and may be rented or purchased by any professional group or individual.

APPROVED FILMS

The Diagnosis and Treatment of Infections of the Hand. Allen B. Kanavel, M.D.

Benign Prostatic Hypertrophy. J. Bentley Squier, M.D.

The Technique of Blood Transfusion. University of Rochester Medical School.

Simple Goiter. George W. Crile, M.D.

Indirect Inguinal Hernia. Daniel LeRay Borden, M.D.

Ectopic Heart. Photographed at the Kansas City General Hospital.

Intestinal Peristalsis. Mayo Clinic.

Acute Appendicitis (for the Public). Edward Martin, M.D.

Acute Appendicitis (for the Profession). Edward Martin, M.D.

Treatment of Normal Breech Presentation. Joseph B. DeLee, M.D.

Development of Fertilized Rabbit's Ovum. Warren H. Lewis, M.D.

Tests of Vestibular Function. Richard S. Lyman, M.D.

Amyotonia Congenita. An already-existing film which has been revised.

During the past year the Board has co-operated with the Eastman Teaching Films, Inc., in giving to the profession information concerning the approved films—the plan under which they are produced, descriptions of the films available, conditions under which they may be obtained, and something of the plans for future work in this field.

A number of additional films now in production will be completed soon, and it is planned to start work on important new films within the next month.

The members of the Board are deeply interested in the talking motion picture, and close contact is being maintained with those interested in all phases of furthering the development of talking films for medical teaching.

The work of reviewing and cataloguing existing films has been continued. During the past year about one hundred reels of such films have been reviewed at the office of the Board in Chicago.

THE LIBRARY AND DEPARTMENT OF LITERARY RESEARCH

THE Library of the College occupying the upper floor of the John B. Murphy Memorial Building has become a fitting expression of the life and work of the Fellows of the College. In the Library have been placed the personal collections which represent the professional activities and interests of recognized leaders in surgery. The complete library of Dr. John B. Murphy which formed the nucleus of the College Library speaks eloquently of his professional interests and the amount of study in his library which went hand in hand with his clinical work. A study room in the College Library contains the personal library of Dr. Albert J. Ochsner and a larger collection of books and reprints which had been housed at Augustana Hospital has been moved into the College Library where it can be made available not only to the staff of that hospital but to the Fellows of the College and members of the profession wherever located. Special collections representing the activity of certain of the Fellows in their chosen field have become the nucleus of important collections in each of the specialties. Two collections of ophthalmological material have been received: one the library of the late Dr. Orrin LeRoy Smith and the other an extensive accumulation of older theses, reprints, etc., obtained through the interest of Dr. Hamilton Stillson. The bound journals, largely foreign, which were the property of Dr. George N. J. Sommer are now a part of the College Library. Dr. H. W. Mills became interested in cases of echinococcus cyst and the collection of material in this subject became a hobby with him. This collection in accordance with his wishes was presented to the College Library.

The Library represents the interests and accomplishments of the Fellows in another way since each section of the Library has books written and contributed by Fellows of the College. There is a place in the Library also for two copies of all articles written by the Fellows, preferably in reprint form, one copy for the loan collection, which is a classified file, and one for the author file, maintained alphabetically according to author.

Another very important collection in the College Library is also an expression of the professional activities of the Fellows; that is, the collection of bibliographies and compilations of abstracts and translations that have been prepared at the request and under the direction of the Fellows of the College. It is all material which has been used by Fellows of the College in the writing of books and monographs and in their experimental and clinical work.

The continued co-operation of the Fellows is welcomed by those in charge of the Library and those coming in this year as well as all who have not as yet sent in their books and reprints, are requested to send one copy each of books and two copies of each reprint. Collections of books and reprints which have served their purpose locally may be added to the College Library. It is well, however, to notify the Library in advance and if possible to furnish a list of books in order to avoid unnecessary duplication.

DEPARTMENT OF LITERARY RESEARCH

The Department of Literary Research is associated with the College Library to make this collection serve the Fellows of the College to the fullest extent, not only those who come to the reading room but all who can be reached by mail and telegraph. The research staff made up of workers in all languages required for comprehensive medical research are continually engaged in compiling data for the College scientific committees and for the individual use of Fellows in connection with the writing of papers or their experimental and clinical work. In individual instances the work varies from the furnishing of a little information for practical use to the preparation of most comprehensive reviews of the literature on subjects outlined for research. Bibliographies are furnished and abstracts and translations of articles are prepared upon request. A file of classified reprints is maintained for loan to Fellows of the College. No charge is made for the loan service. All other research work is done at cost and can be carried out under the direction of the doctor sending in the request as completely as though the worker employed were working directly for him. No charge is included for medical editing and supervision of the work or for overhead of any kind. In some instances copies of material of this character, bibliographies and collections of abstracts prepared in the Department have been returned to the library and released for general use so that there are special compilations to add to the loan service, for example: echinococcus cyst (Dr. H. W. Mills), varicose veins (Dr. H. O. McPheeters), hernia in children (Dr. Frederick W. Lester), and a bibliography on radium in ophthalmology for the years 1903–1924 which was given to the Library by Dr. Laura A. Lane.

This bibliography has been brought up to date in the Department and is available for loan or copies may be purchased. Additional studies will be added in each of the specialties from time to time.

One of the most important developments during the past year is the page for page checking of the current journals. This previously has been limited to the most important surgical journals and to the leading specialty journals. Now the work has been extended to practically all medical and surgical journals, foreign as well as English. This work was undertaken for the benefit of the research work done in the Department for the scientific committees of the College and for the subjects listed for continued research. All subjects listed in the Department far enough in advance of the date when the completed material is required receive the advantages of this checking of the current journals. Not only is the most recent material obtained in advance of its being listed in the published indices, but in many instances data are added which would not be obtained through selection by title.

PHILADELPHIA COMMITTEE ON ARRANGEMENTS

Executive Committee: E. L. Eliason, Chairman; Drury Hinton, Secretary; Brooke M. Anspach, Louis H. Clerf, John D. Elliott, Floyd E. Keene, Fielding O. Lewis, George P. Muller, William J. Merrill, Charles F. Nassau, Damon B. Pfeiffer, John S. Rodman, William T. Shoemaker.

Clinical Program Committee: Leon T. Ashcraft, W. Wayne Babcock, William Bates, John A. Brooke, H. P. Brown, Ralph Butler, B. F. Buzby, G. M. Dorrance, L. D. Englerth, Ralph Goldsmith, J. Milton Griscom, Robert Kimbrough, Edward J. Klopp, A. D. Kurtz, Benjamin Lipshutz, Clifford Lull, P. A. McCarthy, J. J. A. McMullin, George M. Marshall, George H. Meeker, William E. Parke, William N. Parkinson, Ross V. Patterson, William Pepper, William Pierson, Warren Reese, Desiderio Roman, Thomas J. Ryan, William Sheehan, Calvin Smyth, John Speese, Margaret Sturgis, William B. Swartley, Roscoe Teahan, T. Turner Thomas, Martha Tracy, Stephen E. Tracy, Frank White.

OFFICERS ELECTED

President: Allen B. Kanavel, Chicago.

Vice-Presidents: Eldridge L. Eliason, Philadelphia; Ross Millar, Ottawa, Ontario.

Regents for term expiring in 1933: G. A. B. Addy, St. John, N. B.; George W. Crile, Cleveland; Robert B. Greenough, Boston; Allen B. Kanavel, Chicago; John Osborn Polak, Brooklyn.

Regent for term expiring in 1932: George P. Muller, Philadelphia.

Members of the Board of Governors for term expiring in 1933: Brooke M. Anspach, Philadelphia; Fred F. Attix, Lewistown, Mont.; Carl E. Black, Jacksonville, Ill.; Vilray P. Blair, St. Louis; E. M. Blake, New Haven; Herbert A. Bruce, Toronto; James T. Case, Chicago; David Cheever, Boston; Howard R. Chislett, Chicago; Ernest A. Codman, Boston; Robert C. Coffey, Portland, Ore.; William B. Coley, New York; William R. Cubbins, Chicago; Arthur H. Curtis, Chicago; Lincoln Davis, Boston; John B. Deaver, Philadelphia; Gilbert Fitz-Patrick, Chicago; Rufus E. Fort, Nashville; William W. Grant, Denver; William D. Haggard, Nashville; W. T. Henderson, Mobile; Frederic V. Hussey, Providence; Charles E. Kahlke, Chicago; R. D. Kennedy, Globe, Ariz.; Frank H. Lahey, Boston; Dean Lewis, Baltimore; W. H. G. Logan, Chicago; LeRoy Long, Oklahoma City; Frank W. Lynch, San Francisco; Davis W. MacKenzie, Montreal; Edward Martin, Philadelphia; Franklin H. Martin, Chicago; Charles H. Mayo, Rochester; William J. Mayo, Rochester; Angus McLean, Detroit; Alton Ochsner, New Orleans; Fred A. Pittenger, Boise, Idaho; John L. Porter, Evanston; Eugene B. Sangor, Bangor, Maine; Arthur C. Scott, Temple, Texas; Charles L. Scudder, Boston; Harley R. Shands, Jackson, Miss.; Edward Wier Smith, Meriden, Conn.; Ernst A. Sommer, Portland, Ore.; Arthur Steindler, Iowa City; Philemon E. Truesdale, Boston; Charles A. Vance, Lexington, Ky.; John B. Wheeler, Burlington, Vt.; E. Weldon Young, Seattle; Hugh H. Young, Baltimore.

RADIO BROADCASTING

THROUGH the courtesy of the Committee on Publicity of the Philadelphia County Medical Society, Dr. Joseph C. Doane, chairman, arrangements were made for a daily series of radio talks by officers of the American College of Surgeons and several of the distinguished surgeons attending the Clinical Congress. The facilities of broadcasting stations WCAU, WFI, WIP, and WLIT were utilized to present the following timely addresses:

THE AMERICAN COLLEGE OF SURGEONS, SCIENTIFIC MEDICINE, AND THE PUBLIC

FRANKLIN H. MARTIN, M.D., F.A.C.S., Director General, American College of Surgeons; Chicago: Philadelphia has been a great friend and a constant inspiration to the American College of Surgeons. Philadelphia has always been foremost in general medical leadership. Philadelphia has from its beginning been known as the medical center of our country. When the medical world speaks of the beginning of surgery it points proudly to Philip Syng Physick. When it refers to medicine it points to Benjamin Rush. Lay Philadelphia has shared the aspirations of medicine since Rush set the example of reciprocation and entered into partnership with the people. He was one of the leading citizens of his country as well as a great physician.

The American College of Surgeons was organized not only as a clinical association of surgeons, but since its inception has had for its greatest ambition a desire to share with the people a knowledge of medicine and to inspire them to aid in the progress of the prevention of disease. It was one of the first of the scientific societies to organize great public meetings where the lay man and woman can meet the honest specialists in medicine face to face and hear from their lips the facts the public should know about preventive medicine and means through which the public can aid in the program.

Concretely the American College of Surgeons, under the leadership of outstanding specialists, and in co-operation with established clinics and 2,063 approved hospitals, has for 12 years been making an intensive study as to the cause and cure of cancer. Definitely, I am glad to announce that this committee now reports many actual 5 year cures of this dread disease. Our records show that early cases of cancer were cured to the extent of 48 per cent.

This intensive study emphasizes the advantages of close partnership between the scientific medical profession and the public. The people are being educated to recognize early symptoms of cancer and to make their discoveries known to their family physicians at the earliest possible moment. The family physician, on the other hand, has been keen to co-operate with the patient. And early co-operation results in permanent cures.

Many within the hearing of my voice may not be familiar with the early signs of cancer. They are as follows: Listen and remember—A neglected skin blemish or persistent soreness may become a skin cancer. A small lump in the breast is a danger signal and the family physician should be consulted at once; it may be the forerunner of an incurable breast cancer. Persistent indigestion or stomach distress are among the early symptoms of cancer of the stomach, and progress can be arrested by immediate attention. Slight bleeding from the bowel with constipation may be the first symptom of cancer of the rectum. Bleeding, especially between the regular monthly periods of women, is a condition that warrants immediate consultation with the family physician. Have him advise you at once—delay may mean cancer of the womb. There are other signs, but these are the outstanding ones.

Men and women, why not be on the safe side? Why wait for danger signals? Go to the human engineer, your own family physician, once in 6 months and have the human machine thoroughly inspected. Then you will be safe from all diseases. If you should be developing a cancer, it will be discovered in its very earliest stage, when it can be cured.

The American College of Surgeons advocates close partnership between the patient and his family doctor. A periodic health examination is a precaution not only against cancer but against all other serious diseases.

Give the custodian of your health, your doctor, an opportunity to keep you well. Do not wait

until you are seriously ill or beyond his help before you seek his advice.

Hundreds of the most reliable physicians and surgeons in the world are right here in Philadelphia—your near neighbors.

Remember, too, the following fact: There are 2,063 hospitals in the United States and Canada that are approved by the American College of Surgeons; 44 of them are in your own city of Philadelphia, and 167 in Pennsylvania. In many of these hospitals cancer clinics have been organized by the American College of Surgeons—clinics that will be glad of the chance to serve any one who needs help.

It is less costly to keep well than to ignore nature's warnings and suffer the consequences.

WHY DOES THE AMERICAN COLLEGE OF SURGEONS COME TO PHILADELPHIA?

E. L. Eliason, M.D., F.A.C.S., Philadelphia: In 1910 there came into existence The Clinical Congress of Surgeons of North America. This followed the passing of the proprietary medical school and was the result of a protest against the purely medical conduct of medical societies up to that time. It was thought that surgery could be learned best by visiting other surgeons and seeing them work. Consequently several exclusive clinical societies of surgeons and gynecologists were organized. These traveled widely to observe their confrères at work. This "show me" rather than "tell me" attitude became very popular, and measures soon had to be taken to open the doors until then closed to the great rank and file of surgeons. Thus informally in 1910 at Chicago, and formally in Philadelphia in 1911 and in New York in 1912 were held the first meetings of groups of surgeons to advance this idea. At the first meeting there were 1,100 in attendance; at the third meeting more than 4,000 attended.

These meetings held in Chicago, Philadelphia, New York, Boston, and London revealed the fact that much should and could be done to organize, standardize, and democratize surgery as well as improve hospital efficiency and equipment and promote research and preserve inviolate the moral and ethical standards of the practice of surgery. It was conceived that a college or guild of surgeons, comparable or similar to the Royal College of Surgeons of England, Scotland, and Ireland would accomplish these ends. Our present Director-General drafted a plan and presented it to Dr. Edward Martin, of Philadelphia, then president of the Clinical Congress, who approved. Consequently on May 5, 1913, in Washington, 450 surgeons of North America met and launched the American College of Surgeons. With the president of the Royal College of Surgeons of England as sponsor, and Dr. J. M. T. Finney, of Baltimore, as president, the first meeting was held in Chicago, November, 1913, and 1,059 United States and Canadian surgeons were admitted to charter membership.

The College has all these years striven to accomplish its ideals for betterment of service to the patient. Its membership, governed by examination of its applicants, has grown by leaps and bounds, until today its enrollment is 9,500, all qualified surgeons, several thousand of whom are in attendance at this meeting here in our city this week.

Philadelphia has been the meeting place of this illustrious organization on an average of every 5 years since the mother organization met here in 1911. And now, after 20 years, these two will scarcely credit the great improvement and advancement in each other. Today Philadelphia is eminently equipped to entertain such a great organization. Philadelphia, from having been the birth place of American medicine and crediting itself with 30 other firsts, such as the first city to hold quarantine, the first university medical school, the first private maternity hospital, the first dissection efforts, and later the first division between medicine and surgery was made by Morgan, of Philadelphia, etc. Today Philadelphia probably, if not actually, stands as the world's medical center. She can claim this distinction by virtue of the fact that she boasts of 5 great medical schools, the University of Pennsylvania, the oldest, followed by Jefferson, Hahnemann, Woman's and Temple, not to mention the University of Pennsylvania Graduate School of Medicine; that numerous Philadelphia physicians have in the past, as well as at present, held the highest positions in their fields—S. Weir Mitchell, Osler, Da Costa, Pepper, W. W. Keen, Rodman, Deaver, de Schweinitz, Frazier, and many others.

Then, too, Philadelphia medicine boasts justly of the College of Physicians with its wonderful library on medical and surgical subjects. Next, our city has to offer to our visitors some of the finest hospitals in the country. Many of these, even since our guests were here in 1925, have enlarged and expanded to an almost unbelievable degree. Jefferson, University of Pennsylvania, Samaritan, Pennsylvania, Mt. Sinai, Methodist, Misericordia, Jeannes, Germantown, and last of the larger hospitals, Blockley, now known as the Philadelphia General, not to mention many of the smaller institutions,—all have added many

splendid new buildings, bed capacity for more patients, equipment, and research facilities that place our hospitals in the front ranks of the country.

Having had the experience born of entertaining the fellow members of the American College as our guests many times, we feel that our local committee on arrangements can, and has, arranged a program at the hospitals of such a nature, and our central committees have procured speakers, both foreign and domestic, of such a caliber, that the presentation offered by Philadelphia will surpass all that her rival sister cities have offered in the past.

Visiting members of the American College of Surgeons, your Philadelphia fellow members acting as hosts, welcome you, proud of their association with you, proud of being of service to you.

THE PUBLIC'S DEBT TO MEDICINE

MAJOR GENERAL MERRITTE W. IRELAND, Surgeon General, U. S. Army; Washington: In general terms the public owes to medicine increase of days and increased ability to enjoy them by virtue of good health.

From before birth to death in old age, medicine protects the individual. From the days of nastiness in the unsewered streets to these days of solicitous hygiene and public health, medicine has led our communities from filth and filth diseases to cleanliness and civic decency.

Let us consider the individual. While still in his mother's womb he and the mother are looked after and put into the best condition for his first great adventure, birth. And childbirth itself is not now such a certain passage through the valley of the shadow of death as it used to be. The chances of survival for both mother and child have been greatly increased, subsequent invalidism because of injury or infection greatly decreased. And anæsthesia may make childbirth so pleasant as no longer to deserve the harsh terms—labor and travail. Yet, alas! for reasons mostly economic, it does not grow more popular. Even the formerly terrible ordeal of cæsarean section in bad cases has been made almost as simple and safe as an operation for appendicitis.

Birth achieved, the baby formerly ran an enormous risk of death before he had learned to walk or talk. One of the greatest causes of this, summer complaint, infantile diarrhœa or dysentery, which threatened his life as distemper threatens that of the young dog, is no longer widespread. Smallpox, once a common disease of childhood, now scarcely threatens it. The gift of vaccination was one so great as to surpass the comprehension of those who know not smallpox. Other childhood diseases are going the way of smallpox, notably diphtheria, scarlet fever, rickets, and infantile scurvy. They are becoming less frequent, more certainly preventable and curable.

Infancy passed, childhood and adolescence have greatly increased chances for survival. Intestinal parasites, once exceedingly common, are rare in many parts of our country, and, in all parts, of increasing rarity.

Tuberculosis, once "captain of the men of death," claims each year fewer of our youth. Typhoid fever, diarrhœa, and dysentery, long the greatest scourges of our armies, are almost conquered. Venereal diseases are diminishing in frequency, and rheumatism as it occurs in the young has decreased 90 per cent in a quarter of a century, according to army statistics.

All of the acute surgical diseases, such as appendicitis, abscess of the ear, and mastoiditis, are better handled and cause relatively few deaths. As an example of what the public owes to medicine, I quote some army statistics of two years. Soldiers are mostly average young men.

For the year 1903:	
Admissions from disease per 1,000	1,514
Admissions from all causes	1,716
Deaths from disease	12.78
Deaths from all causes	15.49
For the year 1927:	
Admissions from disease per 1,000	526
Admissions from all causes	644
Deaths from disease	2.35
Deaths from all causes	4.00

Youth, spared, lives to middle or old age, and there are thus more subjects for the degenerative or wearing-out diseases, such as chronic Bright's disease, arteriosclerosis, apoplexy, and cancer. Against these we have made less progress, but we are not without hope of making more.

We know more than we did about nervous and mental diseases, and we are able to help many individuals, but the increasing complexity of modern life causes difficulties of adaptation which are beyond the powers of more and more people, and the number of insane increases.

To medicine the public owes its education in the appreciation of sanitation. The deviltries of the fly and the mosquito were revealed by military doctors, and the knowledge of such deviltries has enabled us practically to abolish yellow fever and to check malaria, the greatest scourge of the tropics, while in our own country our knowledge of the fly's wickedness has been important in reducing the incidence of typhoid, dysentery, and other intestinal infections.

But I do not wish to claim too much. Medicine alone has not wrought all the improvement in public health. The engineers deserve credit for good municipal water supplies and systems of waste disposal. Still more credit should go to this machine age, to labor unions, and to enlightened employers for increased wages and higher living standards, with better food, clothing and shelter, more rest, and greater leisure; to general diffusion of education for reduction of ignorance and fear, which rank next after infection and deprivation as causes of suffering. But medicine has had a large part in making life safer, pleasanter, more worth while, in broadening the habitable world and making it a safer place for living. This has been accomplished through combat, and some of the combatants have lost their lives. Medicine honors these among its heroes.

SCIENTIFIC MEDICINE: A FACTOR IN INTERNATIONAL RELATIONS

GEORGE GREY TURNER, M.B., M.S., F.R.C.S., Newcastle-upon-Tyne, England: From time immemorial, medical progress has depended on interchange of experience and knowledge between peoples, and since the dawn of time there has been evidence of the importance of medicine as a factor in the life of every nation. Even in the middle ages and largely in the Renaissance there are records of the travels of the medicine men of those days to seek knowledge and inspiration in other lands, and each one must have been a factor in spreading this knowledge to his own people. Near my home in the north of England, remains of the Roman occupation abound and there is evidence, as shown by the discovery of surgical instruments and inscribed medical stones, that the Romans who conquered Britain and who garrisoned the Wall possessed a high degree of medical knowledge. Doubtless this was a factor in promoting the better relationships between the invaders and the Celtic people with whom they intermingled, and probably the Roman occupation had as great an effect as the result of the medical aid which they could proffer as from the laws and the administration of justice. The discovery of the methods for the prevention of infection in wounds by Joseph Lister was one of the greatest aids to international knowledge, and as a result of his beneficent work international friendships were made or consolidated in a most wonderful way. Visitors from the far corners of the earth traveled to watch the work of the master both in Scotland and in London, firm friendships were made and mutual understanding promoted, and the priceless benefit of his discoveries were thus enabled to penetrate everywhere.

At a previous visit which I paid to your delightful city 24 years ago I was most interested to discover a museum of pathological specimens which had been brought to your country by some of the surgeons of those days, perhaps Benjamin Rush or the elder Gross, who encountered great hardships and trouble in their determination to visit Europe to see the work of the great masters in medicine, such as Dupuytren, Astley Cooper, Syme, and others. In the campaign in Mesopotamia in the Great War, which is still so vivid a memory, one of the most notable features was the influence of our medical administration on the peoples of that arid land, and if our presence was irksome in many ways we were at least appreciated for the sanitation which we introduced and for our medical aid freely extended to the population. Today scientific medicine is a great international force. Now every discovery flashes across the world, but the best way to promote international relationships is by the actual personal contact of medical men from all countries with one another. Each can be an ambassador, and this should be the constant aim of the visiting physician.

Such close personal contact is promoted by associations like the Clinical Congress of the American College of Surgeons now meeting in this city, but there are many smaller traveling clubs that have been formed for the most part by the English speaking peoples, which have wielded a great influence in molding international relationships.

The freemasonry of our profession is a guarantee of welcome the world over, and it would be a surprise to any other community or profession to discover such an international assembly as may often be found in any of the great cities.

Fortunately for the promotion of medical knowledge, while the world changes man is always the same, and the problems which confront the medical man in one part of the world are similar to those elsewhere, and everywhere the Angel of Death is waiting to do battle for its victims.

Owing to the high ideals of our calling, secrecy has no place in our armamentarium and every addition to knowledge becomes common property. This more than any other factor must always remain a powerful weapon in cementing better international relations.

THE DIVIDENDS OF MEDICAL SCIENCE

ALLEN B. KANAVEL, M.D., F.A.C.S., Chicago: Modern medicine is the triumph of patient, per-

sistent, scientific research over the inherent tendency of mankind to attribute anything one does not understand to supernatural power.

To realize that foolish beliefs are not extinct, we have only to remember that even in our day some people carry a buckeye to prevent rheumatism.

There was even up to 1850, little real knowledge of the specific cause and cure of a majority of diseases. Since that time the plague, yellow fever, diphtheria, scarlet fever, puerperal fever, sepsis, typhoid and typhus fever, cholera, to mention only some conspicuous examples, have lost their terror; aseptic surgery, until then unknown, has developed its life-saving procedures; physiology and chemistry have shown the way to the cure of diseases of function, such as diabetes and pernicious anæmia.

The plague appeared in Europe in 1348, after devastating Asia and Africa, destroying, it is said, one-fourth of the population of the earth. To mention only a few of the many epidemics, the London epidemic of 1665 carried away 69,000; Vienna of 1679, 70,000; Prague of 1681, 83,000; Prussia of 1709, 283,000; Moscow of 1770, 52,000 out of a population of 230,000. Five years ago the plague appeared in San Francisco and probably the United States would have been ravaged, but due to medical science, the flames were stamped out almost before they appeared. Contrast these two pictures, and then dare to ask if in that one victory alone medical science has not paid full measure for all its years of patient study, for all the endowments of a generous public in support of medical education, and for the faith of the world in its ideals. But this is but one of its victories.

Cholera has been endemic in India for centuries. It spread over Russia in 1830, skirted northeastern Germany, reached England in 1831, and the next year invaded America through Quebec and New York, with great mortality. Since that time medically supervised sanitation has walled it up in India, where ignorance still permits its appearance. Again, has medical science paid its dividends to the public?

Before Jenner introduced vaccination, Dr. Lettson says that most children in London had smallpox before the seventh year. In 1518, smallpox reached America and 3,500,000 persons died in Mexico. From 1893 to 1897, 275,502 persons died in Russia of the disease.

In 1873, Germany, with many times the population of Prussia alone, made vaccination compulsory, and in 1897, in a population of 54,000,000 there were only 5 deaths from smallpox. In the United States, unfortunately, ignorant people insist upon their personal rights and prevent the application of equally wise laws.

During our small Spanish-American War, with only 225,000 soldiers under arms, 10,428 contracted typhoid, of whom 600 died. Contrast the picture with that during the late World War, with 4,000,000 men under our colors, in which, due to typhoid vaccination, but 768 contracted the disease, and only 120 died. The same rules applied to civil life are rapidly stamping out the disease.

Diphtheria, yellow fever, malaria, scarlet fever, hookworm disease, infantile paralysis, and many others with their antitoxins, but repeat this wonderful story.

Almost the entire field of surgery has developed since asepsis permitted our invasion of every part of the body. Think what it would mean if the suppurating appendix could not be removed, the ovarian cyst not eradicated, and the cancer of the stomach not excised, and if the thousands of patients with other lesions were permitted to go their way untreated to an untimely death.

The conquest of scurvy, pernicious anæmia, and similar metabolic diseases has laid the foundation of a new branch of medicine. The victory over pneumonia, cancer, and other diseases that still baffle us will come—not by luck, chance, or prayer; not through the charlatan, the religious fanatic, or the ignorant experimenter; but by patient, persistent, unselfish toil on the part of the trained medical scientist.

SCIENTIFIC MEDICINE AND THE PUBLIC WELFARE

GEORGE DAVID STEWART, M.D., F.A.C.S., New York: My theme is the relation of scientific medicine to the welfare of the public, a theme so broad that only one or two points can be touched on in the brief time allowed to me.

Now whether you are aware of it or not and whether you like it or not you are in intimate contact with scientific medicine from your cradle days, and even before, until you sleep your last sleep. Even if you are well-endowed physically, are so healthy as never to need a doctor personally, still public medicine, particularly that relating to contagious diseases and to epidemics, is under legal control, is practiced in every intelligent community, and consciously or unconsciously you are the beneficiaries of these salutary sanitary regulations. Smallpox and diphtheria will serve as two examples.

Not long ago diphtheria was a dreaded scourge that often entered a community and left only after

reaping a grim harvest. Today medicine not only cures but prevents the disease and even goes so far as to tell with exactitude whether one is strongly or only mildly susceptible to the disease. The other, smallpox, has almost been banished by vaccination and even in remote districts epidemics are rarely severe because almost every one has been subjected to one or more vaccinations which, if they do not entirely prevent, at least markedly modify the severity of the disease.

Beyond this what has scientific medicine to offer you? Much! Much more than ever before in all the world's history. That there have been good doctors in the past is undeniable. Good doctors have existed in every stage of civilization's progress; otherwise you would not be out there listening and I should not be here speaking to you. But in recent times, say the last half of the last century and in the years that have already fallen from this, science has made tremendous strides in many directions. Some of these are of direct advantage to medicine and through this channel they can come to you.

For example, chemistry, which has broadened its field enormously, has made many contributions to medicine. It has taken drugs, that were known to be of value in the treatment of disease but which yet contained some dangerous elements in their composition, and has analyzed them, removed the deleterious matter, and handed back to the doctor the drug retaining only its medical virtues. Or it has by synthetic processes built up new bodies that "never were on sea or land," some of these vastly useful as medicine.

Working in conjunction with physiology it has taught us many of the profoundly difficult laws of metabolism, that process by which the body turns bread and butter, fish and flesh, into bone and muscle and energy, and even spiritual contentment and honesty. Thus the laws relating to diet, not so simple as those in force in the household of Jack Sprat and his wife, but on the contrary profoundly abstruse, are being made clearer and clearer to you every day, not merely that you may be sylph-like but to the end that you may be healthy and therefore happy; wealthy, in that you possess an abundance of good health; and sometime, who knows, even wise.

In the matter of contagious diseases, or some of them at least, medicine has found the cause, thanks to that great man Pasteur who lived about the beginning of this great scientific awakening; and, thanks to the same great man and to those dedicated spirits who followed and who gave themselves without rest to the search for truths helpful to human need, we have also found the cure or means of modifying the virulence of these diseases. However, the complexity of life is constantly increasing and with it the strain of living. Here is one direction in which scientific medicine cannot benefit you unless you, the public, are willing to co-operate.

The annual death rate in contagious and infectious diseases has been materially lowered in some instances almost to the vanishing point, but in those diseases due to strain and improper diet, diseases in which the heart, the blood vessels, and the kidneys suffer most, the rate, instead of falling, is increasing. Why? Because medicine can not bring this about alone. It must have your concurrence.

Our society and laws are jealous of the rights of the individual, and there are few ordinances on the statute books telling us what we shall eat, what we shall drink, or wherewithal we shall be clothed, one famous sumptuary law to the contrary notwithstanding.

How can you give this co-operation? By submitting yourselves yearly, or better, twice a year, to a medical examination by your family doctor to see if all departments of that wondrous machine, your body, are working harmoniously, are clicking properly; to ascertain the first variation from the normal; to find this variation in time while it may well be cured rather than to wait until it is chronic and must be endured so long as you may live.

Who will make this examination? Your family doctor. If you have no family doctor secure one as soon as possible. It is very comforting if you should waken in the night seriously ill to have in your memory or on a convenient pad the telephone number of a doctor who is your trusted family friend rather than to set about in those distressing moments to find one. That family is poor minded that does not have a family doctor. You may argue that the old breed of family practitioner is or will soon be extinct in this age of specialization, but you are wrong. There are many family practitioners to be found. Besides, your doctor-friend need not of necessity be a general practitioner. He may be a specialist but since he is a man of character you can trust him to find the doctor who will best understand your case.

The dailies of New York become religious on Monday and print abstracts from the pulpit's utterances of the Sunday before. In one of these printed last Monday the speaker, a well known dean, said of a well known hospital: "In the last 35 years I have had a great deal of experience with that institution, and let me say that the miracles

of the past under God are being repeated today in that hospital. Think what it must mean to a man to be brought back to health in such a hospital. It is no wonder that doctors gather the love of the people. I envy the position of the modern doctor, the confidence which the family doctor receives, and a confidence which he well deserves."

I like to think that our profession will continue in this way, that it will never advertise, nor ever change its vocation into a business; and on that tribute from another profession let me thank you and end.

HOW SCIENTIFIC MEDICINE CAN BEST SERVE THE PUBLIC

RICHARD R. SMITH, M.D., F.A.C.S., Grand Rapids, Michigan: Scientific medicine belongs to you. It is the accumulated knowledge gained by thousands of scientific workers who for centuries have been freely contributing the priceless results of their labors to the world for the benefit of mankind. Scientific medicine has played, and continues to play, a most important part in the development of America by conserving the health of her citizens. It has prolonged life, prevented the untimely death of countless millions, and relieved untold suffering. Its benefits are your heritage, valuable beyond estimation. As great as have been its accomplishments in the past, as great and good as is its influence at present, we may expect even greater things in the future, for under the direction of its leaders scientific medicine is going constantly forward in the prevention, the cure, and the alleviation of disease.

One of the ways in which scientific medicine can best serve the public is through our public health service. You have been freed from the ravages of most of the great epidemics and may go where you will with but little fear of contagious disease. This has been brought about by your public health service. It isolates those with contagious diseases, maintains great laboratories for the purpose of ferreting out and identifying foci of infection, guards your food and water supplies, furnishes you with vaccines and serums to render your bodies immune to some of the most dreaded and fatal of the infectious maladies. It encourages cleanliness and other wholesome influences and instructs you in regard to the health of yourselves and your children.

Another way in which scientific medicine can best serve the public is by advancing education in health matters. It is only in recent years that doctors have taken this seriously in hand. Organized medical bodies have begun to give you through the press and by lectures and clinics reliable information in regard to matters of health and sickness. This movement has only just begun, but it promises great results for you.

"Yes," you ask, "but how can scientific medicine best serve me and my children individually, personally?" The answer in brief is, "Select a doctor, a member of the regular profession, to whom you may take all your problems of health and sickness."

Men qualified to act as your medical advisers may be found in almost every community. Because the practice of medicine is difficult, and in ignorant and unskilled hands unsafe, the state provides for the education of men in medical practice. It demands that those who practice scientific medicine shall be duly qualified and registered as physicians in the state in which they follow their profession.

In the selection of a medical adviser for yourself and family, a physician of broad medical experience is usually best. The medical profession regrets the gradual passing of the family doctor, not only because of his broad practical knowledge, but because he knew his families and their individual characteristics intimately and was a family friend in whom parents and children could place confidence in time of illness. Many such men are still to be found and the policy of depending upon them is sound. From the general practitioner or family doctor is slowly evolving the internist who has a wide knowledge of medicine, particularly in diagnosis. Such men are to be found in all of the larger communities. You will find that they will be glad to act as your family advisers. If your problems are particularly those of your children, you may well go to a pediatrician who is really an internist who limits his practice to children. He will give you expert advice in regard to them both in sickness and in health.

In the selection of your family physician certain points might be emphasized. He should be a man of integrity who will act always for your interest. He should be a man well educated in scientific medicine and well informed in its advances. He should be a man who is in the habit of attending medical meetings and of mixing freely with his fellow physicians for he will be more valuable to you on this account. The good doctor of today, alive to the intricacies of scientific medicine, seeks counsel frequently from specialists. He knows best their qualifications and will advise you wisely in regard to the selection of such a man if you happen to need one.

When you have selected your family doctor continue with him so long as he deserves your

confidence. Make a friend of him. I cannot emphasize too strongly that close prolonged contact between patient and doctor are of prime importance in rendering and obtaining good services.

Another way in which scientific medicine may best serve you is through an annual health examination made by your doctor, who will act with specialists in determining your state of health and the soundness of your organs. He may be able to give you advice as to habits and modes of life which will avert many of the diseases that creep on insidiously, do irreparable damage, and shorten life.

In all of these and various other ways scientific medicine can best serve you. It is indeed a friend in sickness and in health.

HOW THE PUBLIC CAN ASSIST IN REDUCING THE MORTALITY OF CANCER

C. JEFF MILLER, M.D., F.A.C.S., President, American College of Surgeons, New Orleans: Half a million people die annually from cancer, a wastage of human life that seems even more terrible when we consider that in large part it can be prevented. It is due to two chief causes, ignorance and delay, both of them inexcusable causes, both of them remediable causes, provided only that the public and the profession work hand in hand to remove them. The medical profession must share its knowledge with the people, must teach them what cancer is, so far as they themselves know, must instruct them how to avoid it before it occurs, must teach them how to act when once it has developed.

To treat a disease intelligently its origin must be known, and in this regard cancer is unfortunately still a largely unknown disease. But even though we do not know its exact origin, we do know that practically without exception it is preceded by chronic irritation which has lasted over a long period of time. Let me illustrate. Cancer of the skin can be traced to unhealed sores, to ulcers, to scar tissue, to certain types of warts and moles, and to similar lesions. Cancer of the lip and jaw and tongue is caused by excessive smoking, by pipe and cigar burns, by bad teeth, particularly jagged teeth, and by mouth infections. Cancer of the stomach and other portions of the gastro-intestinal tract is preceded by indigestion, by ulcers, by constipation, by diarrhœa, or by bleeding hæmorrhoids. Cancer of the breast is preceded by bruises, by lumps, and by discharges from the nipple. Cancer of the genital organs is preceded by infections and by childbirth injuries. Always chronic irritation of some sort precedes the development of cancer itself, and the prevention and correction of these precancerous lesions, the removal of these chronic irritations, will avert the development of cancer in the vast majority of cases and will automatically lower its mortality.

Again, cancer always begins as a local disease, never as a blood or a constitutional disease. Since this is so, it follows that the removal of the growth while it is still local will mean, in most cases, absolute and permanent cure. We prevent the spread of smallpox by the isolation of single cases. We prevent an epidemic of scarlet fever by strict quarantine. In exactly the same way we can prevent the spread of cancer by the removal of its point of origin, provided that it has not yet extended beyond that point. If we can put out a fire that is just beginning, we shall not have a general conflagration.

The chief reason people die from cancer is that its initial signs are so simple no attention is paid to them. If it began like a jumping toothache there would be no deaths from it. But there is nothing painful about early cancer, nothing striking about its first manifestations, and we can defend ourselves against it, therefore, only by investigating all untoward symptoms, especially when we have passed into the so-called cancer period of life. Better yet, we can submit to periodic examinations and thus prevent the development of the disease. We must realize that every departure from the normal, every evidence of the abnormal, every disturbance of function, must be promptly investigated, because while it most often is of minor significance, it may be the first indication of malignant disease.

Cancer does not cure itself; therefore some form of treatment is always necessary. There is no specific remedy, no certain cure for it, therefore flee from the advertised cancer cure as you would from the plague, for death stalks in its wake. Irradiation and surgery achieve very remarkable results, provided they are applied promptly, for promptness of treatment is the most important consideration. Even better than treatment, however, is the removal of chronic sores, the elimination of chronic irritations, the correction of the conditions that predispose to cancer, for an ounce of prevention in this special disease is worth many pounds of cure.

Cancer is truly "captain of the men of death," but that is more the fault of the public than of the medical profession. Doctors cannot cure people who will not submit to examination and treatment. It owes its appalling mortality not nearly so much to its intrinsic virulence as to fear and ignorance and consequent procrastination.

Therefore, my message to you today is to prevent and correct the conditions which cause cancer, to submit yourself to prompt diagnosis and treatment if you suspect that you have it. Only in this way can the mortality of this dreadful disease be brought within reasonable limits, and whether or not this can be achieved rests much more with the public than with the medical profession.

THE WORLD FIGHTS CANCER

WILLIAM ERNEST MILES, F.R.C.S., London, England: One of the greatest and most relentless enemies of the human race is the disease known as cancer. In every country in the civilized world an increasing number of cancer cases are treated in medical institutions. Because so many factors have to be taken into consideration, it is difficult to say whether a larger proportion of the population are now affected. The cause of cancer is as yet unknown, despite the continued labors of many thousands of earnest workers in cancer research throughout the civilized communities of the world. The conundrum is one of infinite complexity and up to the present has baffled all efforts to unravel it. As the result of these researches, however, some progress is being made toward the elucidation of the problem.

It may well be that if one could undo the harm that has been done to the physiological resistance of the individual through generations of vice and indiscretion there would be no cancer because each individual would then inherit full measure of physiological integrity. We cannot, however, alter the past, but we can take care of the future and in the meantime our efforts must be concentrated upon using all the available means at our command to facilitate research.

In England a great effort is being made by an organization known as the British Empire Cancer Campaign to co-ordinate the efforts of the cancer research workers throughout the Empire. Branches of the organization have already been established in Australia, New Zealand, and Canada. By means of this co-ordination of effort it is hoped that both time and money will be saved by each center of research being aware of the results of the labors of others, thus preventing overlapping. I have no doubt that in the course of time every great nation will have inaugurated a similar organization, when it will be possible to establish a liaison between them, because this is a world war, and not the concern of any nation individually.

In the meantime, cancer is with us and its ravages must be combated with all our resources. Cancer is no respecter of persons. Rich and poor alike are counted among its victims.

Cancer can be cured by surgical operation. It is essential, therefore, that the earliest possible signs of disease should be investigated by experts. Tumors are not cancerous, but it is better to be told that a tumor is a non-cancerous condition than to omit to subject a cancerous tumor to investigation. Cancer does not brook procrastination; it is insidious in its onset, relentless in its progress, and often during the space of a few months advances beyond the stage of possible removal by surgery.

For regions in which the efforts of surgery have been unavailing and for advanced cases in regions amenable to surgery, the penetrating rays of X-ray and radium have been tried in the hope that their rays would destroy the cancer elements. Radium appears to hold out the better prospects, some encouraging results having been obtained occasionally in some situations. Nevertheless, no extravagant hopes in regard to this method of treatment can be entertained at the present time. Radium treatment of cancer, however, has met with some measure of success and, therefore, it must be tried out in the best possible way and under the best circumstances. Radium must not be applied in a haphazard manner as more harm than benefit will result. In England a determined effort is being made to standardize the use of radium by establishing centers throughout the country. The Radium Commission is responsible for this organization, and it is hoped that definite results may accrue in the course of time. At any rate, it will have been tried out thoroughly and at the end of 5 or even of 10 years the Radium Commission will be in a position to estimate the value of radium in the treatment of cancer.

For the present, the cancer problem can be summed up in two lines taken from Tennyson's delightful poem, "Lockesley Hall":

> "Knowledge comes, but wisdom lingers; and I linger on the shore,
> And the individual withers, and the world is more and more."

THE PREVENTION OF CANCER

ROBERT B. GREENOUGH, M.D., F.A.C.S., Boston: Vaccines and serums for the prevention and cure of diseases like diphtheria and typhoid fever are prepared by the repeated inoculation of the germ causing those diseases into animals to produce a protective antitoxin, or into man to make him immune to that particular disease.

Unfortunately no such method of prevention or cure for cancer is possible because cancer is not

produced by any germ. Cancer is an abnormal growth of the cells of the human body, and it is produced by many different agents. Cancer can be produced in animals experimentally by the long continued irritation of chemicals, like coal-tar, and cases of cancer in man are not uncommon in workers who are exposed to coal-tar and similar irritants in industry. In such cases there is a long, long period of irritation and inflammation of the skin, gradually increasing in severity. This may last from 10 to 15 years before cancer finally develops, but when it comes it has all the characteristics of the disease in other situations and destroys the life of the individual.

Conditions of this sort, which are recognized as precursors of cancer, are called precancerous diseases. Such conditions can be cured before they become cancerous, and it is in this way that we can truthfully speak of the prevention of cancer. In such a case cancer is prevented just as definitely as typhoid fever is prevented by vaccination. One or another form of chronic irritation is found to exist as a precursor of almost all forms of external cancer and in some of the internal forms as well.

Cancer of the tongue and mucous membranes of the mouth is perhaps one of the best examples of cancer arising in a previously benign precancerous condition. The chief sources of irritation here are bad teeth, the use of tobacco, and syphilis. As a result of one or more of these causes sore spots, ulcerations, or thickenings of the mucous membranes of the mouth occur, which sooner or later become cancerous if they are not corrected. In the precancerous state these troubles can be cured by correction of the underlying causes and by simple appropriate treatment. In such cases cancer is prevented.

Another situation in which injury and inflammation provide fertile soil for the development of cancer is the neck of the womb. As a result of childbirth, lacerations of the neck of the womb are almost inevitable. If these lacerations are not accurately repaired ulceration and inflammation are likely to occur, and cancer is prone to develop. Cancer of the neck of the womb is one of the most common and most serious forms of cancer, and attacks exclusively women who have borne children. Its occurrence can be prevented to a great extent by correction of the precancerous lacerations and erosions before the change to cancer has taken place.

Many other precancerous conditions are recognized in the form of ulcerations and thickenings of the external skin, benign tumors and diseases of organs such as the breast, thyroid, ovary, bladder, and indeed of almost every organ of the human body. The correction and cure of these diseases in the precancerous stage has become an important part of the work of the modern cancer clinic, and prevents the occurrence of cancer in countless individuals.

The individual who desires to protect himself from cancer must be alert to detect the signs of chronic irritation. The moment such a condition is observed the family physician should be consulted. If necessary, he will arrange a consultation at the nearest cancer clinic, and the condition can be recognized and given the necessary treatment.

THE CANCER MENACE

HOWARD A. KELLY, M.D., LL.D., F.R.C.S., F.A.C.S., Baltimore: Cancer is today a greater menace, a more formidable scourge than any other malady threatening our national life, with the exceptions of crime and the drink habit. It is becoming a far greater affliction year by year than all our sacrifices in the World War, for more than 100,000 of its victims lay down their lives every 12 months in these United States after several years of ever-increasing sufferings.

With all our efforts, experimentations, and investigations, we are as yet far removed from any worthwhile knowledge of the ultimate cause or causes of this dread enemy. Cases multiply on all sides as the disease creeps back from an incidence formerly peculiar to old age, to rob youth of its immunity. Surely such a world calamity calls for unremitting intensive attention, with the endowment of whatever agencies are trained to work out the formidable problem.

We have laid bare about all that can be seen under the microscope, which has become the final court of resort in reaching a decision as to whether or not a given case is cancerous, as well as in serving to guide our treatment. In spite of the many, almost insuperable, obstacles still in our path we have, nevertheless, stored up a lot of precious lessons.

First of all, we know for a certainty that cancer is not contagious, so we need never fear a case in the house nor subject a sufferer to humiliating or harsh treatment.

Next, like every other ill in life, it is most successfully treated in its earliest stages when it is more curable, for we know that it begins as a purely local affair and is never at the outset a blood disease as many imagine.

Again, we save a lot of lives by bearing in mind its prophylactic or preventive treatment.

The golden rule of prevention is to look upon every persistent sore or lump in the skin, breast,

mouth, or any accessible part of the body as potentially serious until a competent doctor or surgeon declares otherwise. As to the query often raised whether it is best to treat it at once or to "watch it," the best surgeons today, I am sure, are overwhelmingly for a prompt removal or at least for getting tissue for the microscope. If the report reads cancer, then a wide extirpation is urgent.

Prophylactically also, it is often observed that a long-continued irritation in any part of the body may cause cancer at that spot. This is peculiarly dangerous when the lesion is a mole, especially one of the black, warty kind, rubbed, perchance, by clothing or impinging on a collar button, or cut in shaving or again, worst of all, is scratched repeatedly. This desire to scratch a mole is often evidence that trouble is under way. Tobacco commonly causes cancer of the mouth and foul teeth are a dangerous concomitant. The breast is a danger zone in women, where thousands of cancer fires are lighted yearly. No tumor of the breast should be treated lightly and neglected. An unusual discharge must never be construed as purely physiological. In such an event, see your doctor promptly for a thorough examination. Patients and doctors, alas, still have much to learn in this field so full of troublesome weeds: the former to report at once any of the abnormalities mentioned and any others not named; the latter to act with prompt decision and to see the matter through to a diagnosis and then, if cancerous, with a like promptitude to see that the final steps are taken looking toward a cure. The sad habit of watching lumps or lesions until their nature becomes obvious, and both doctor and patient are at length persuaded that "something ought to be done," is responsible for the loss of many precious lives.

WHAT CANCERS CAN BE CURED

BURTON J. LEE, M.D., F.A.C.S., New York: Cancer is a curable disease. This is a true statement if the disease is discovered in its early stages. The symptoms of early cancer may appear of little importance to the patient but their significance is readily appreciated by every good doctor. Pain is almost never a symptom of early cancer. The public at large must realize the importance of this statement for over and over again the patient will say, "I thought this condition of little importance because it was painless."

Some forms of cancer because of their situation or accessibility can be more effectively treated than types of the disease affecting the internal organs.

Cancer of the skin is a readily curable disease. It begins as a rough, slightly elevated area on the surface of the skin and later the area begins to scale. As the disease progresses the diseased spot becomes more noticeable, thicker, and a scab may form over it. In both of these stages the disease is readily cured if an adequate dose of radium is applied. Every doctor is not competent to handle radium and treatment of this sort should be in the hands of men specially trained in this field.

Cancer of the lip is one of the most curable forms of malignant disease. It begins as a small, scaling patch which later is covered by a scab. This patch almost invariably appears upon that portion of the lip where the cigarette, cigar, or pipe-stem has been habitually held. Cancer of the lip can be completely removed by radium treatment. Added treatment by X-ray and a surgical operation may be necessary to effect a cure.

Cancer of the tongue in its early stages is a small, slightly tender projection on the tip or surface of the tongue. This form of cancer is an exception to the general rule that cancers are painless. Cancer of the tongue usually appears where a jagged, sharp, or irregular tooth has pressed against the side or tip of the tongue. In most instances, patients developing cancer of the tongue have been careless about the cleanliness and hygiene of their mouths. This disease is readily cured by radium treatment. In addition, some form of surgical operation may have to be carried out. In all cases of cancer of the tongue, jagged or irregular teeth must be smoothed off or removed, and a proper mouth hygiene instituted.

Cancer of the breast, seen early, is a curable disease in the vast majority of cases. In almost all cases the first symptom of cancer of the breast is a painless lump which the woman may discover quite accidentally. Sometimes the first symptom of cancer of the breast is a bloody discharge from the nipple. Cancer of the breast may begin with a slight depression of or irritation about the nipple. Whatever the symptom referable to the breast, the rule to be followed is to see at once a competent surgeon so that a careful examination of the breast may be made. Early cancer of the breast, treated by a combination of irradiation and a well done surgical operation, will yield a cure of this malady.

Cancer of the large bowel is completely localized to the bowel for a very considerable period, the glands in the neighborhood not being invaded until a later date. This form of cancer is one of the most favorable diseases, for complete removal by surgery and a good surgical operation will effect a cure in the great majority of cases.

Cancer of the uterus is one of the most curable forms of cancer. In the beginning, cancer of the neck of the womb is a sharply localized disease. At this stage it is unattended by pain, but there is almost invariably a vaginal discharge which is ofttimes bloody. Radium treatment completely cures the malady if the patient presents herself in one of the early stages.

Cancer of the body of the uterus is also curable by means of a thorough, surgical operation. One of the early symptoms of this disease is a vaginal discharge which is frequently bloody.

There are many forms of cancer that are curable if they are discovered in an early stage. The only safe rule for each one of us to follow is to have a complete physical examination every 6 months. Early cancer is not the only malady which may be disclosed, if this rule is followed. Many other forms of disease, such as heart disease, kidney disease, or tuberculosis, may be discovered. If each individual in this country, 35 years of age or over, would make it a rule to have a thorough, careful, going-over every 6 months, the cancer problem would be largely solved and many lives saved every year.

Cancer, in its early stage, is a curable disease.

CANCER OF THE FACE AND MOUTH

WILLIAM H. G. LOGAN, M.D., F.A.C.S., Chicago: In our brief discussion of the problem of cancer of the face and mouth, it would seem appropriate to review not only cancerous but precancerous lesions as they make their appearance in the mouth or on the face, in order that we may assist in reducing the fatalities from this source. Everyone will appreciate such a need when, according to reliable information, it is estimated that there are today in the United States between 400,000 and 500,000 individuals suffering from cancer, and the annual increase of this disease during the past few years has been at the rate of about 2.5 per cent.

With this annual increased frequency of cancer in mind, let us pass to some practical application whereby we can assist in reducing the number occurring in the mouth, jaws, tongue, and upon the face. We frankly approach the question with the admission that we do not know the cause of cancer, but during the last 10 or 15 years the element of chronic irritation has been accepted as of great importance in its origin.

The more important precancerous lesions occurring upon the face are the pigmented moles; not that all moles become malignant, but they should be looked upon as having inherent possibilities of such development, and if their location is such that wearing apparel may cause irritation, without regard to their location, they should at the first sign of increase in size or color be removed at once. A crack in the lower lip that continues over a number of weeks without healing must be looked upon with suspicion unless it makes its appearance in the winter and the patient has reason to believe the crack can be accounted for by his exposure to severe and sudden changes of weather which are often present in our northern climate. Should the crack in the lip be present in the location where a pipe or cigar is constantly held while smoking, the individual should immediately consult his physician to ascertain whether or not the lip is involved with the beginning of a cancer that may terminate his life if not properly treated. Cancer of the mucous membrane of the mouth and tongue has often been held to have been the result or sequence of chronic irritation, while other predisposing factors are thought to be found in alcoholism and the excessive use of tobacco. Each individual should do his part to keep his mouth in a wholesome, sanitary condition and avoid those things that might cause local irritation, and the instant any change from the natural condition is observed, such a patient should report to his dentist and physician for examination.

Before concluding, let us return to the question of the probable relation between irritation within the mouth and the development therein of cancer. It should be made clear that rather constant irritation of the epithelial cells or surface mucous membrane will not always result in cancer, for experiments with repeated burning, scalding, or X-ray exposures of more than 100 mice all gave negative results, since the proper dosage and character of irritation had probably not been produced; whereas, irritation with tar to the skin of certain animals has been known to give a prompt and successful development of cancer.

Therefore, with the foregoing picture in our minds, we should conclude that irritants in the form of dental appliances, sharp edges of cavities, and root fragments should be avoided by taking the necessary steps to have them removed. When white blotches or horny patches of mucous membrane are seen on the inside of the cheek, caused perhaps by holding tobacco in a given area or the drawing of warm smoke through a pipe to a given location, the individual should discontinue this form of irritation. These precancerous lesions should be examined by a competent physician and removed if indications seem to justify, the point being that we can best reduce cancer deaths by removing precancerous lesions. If everyone

will make it his impelling responsibility to seek and have examined all tissue that he believes is undergoing change in color or the development of small lumps, I am certain there will be a definite reduction in the death rate from cancer. If a patient waits until these moles and cracks in the lips, white patches on the mucous membrane, and nodules or lumps develop on the tongue or cheek before reporting to his physician, the stage will probably be reached in the development of a cancer where it is easy to diagnose the involvement clinically; and every individual should keep in mind that when a cancer can easily be diagnosed it has reached the stage where it is difficult to bring under control and save the life of the patient. However, if cancer of the lip, cheek, or tongue presents itself, not in the early stages, but in the early days of its involvement, there is not only a reasonable, but a definite, opportunity yet existing to save the life of the patient.

As has been previously indicated, the best way to obviate the serious involvement of cancer is to report to a physician upon the first change in the tissues from normal, and it is equally true that the best way to avoid many serious diseases is to make it a rule to have a complete physical examination annually on your birthday.

THE AMERICAN COLLEGE OF SURGEONS AND CANCER

BOWMAN C. CROWELL, M.D., Director of Clinical Research, American College of Surgeons, Chicago: The annual Congress of the American College of Surgeons is in progress in Philadelphia this week. Every year this great body of surgeons from all parts of the Western Hemisphere meets in one of the larger medical centers of the country to discuss better ways of keeping people well and of improving the treatment of those who do get sick or injured. The activities of the American College of Surgeons constitute another great altruistic effort on the part of scientific, well-trained, medical men in behalf of the public seeking to organize and diffuse a knowledge of the latest and best tried and approved methods of treatment.

Naturally cancer occupies a large part of the attention of the organization because of the fact that this disease causes yearly the death of approximately 150,000 people in this country. This means that twice that number have the disease at any one time. These figures are appalling and are much larger than they need be, for much cancer can be prevented, and many cases can be cured if treated in the early stages.

Scientific committees of the College have been working on various phases of the cancer problem for the past 10 years. In cases of bone cancer they have shown that treatment is not always futile and we now have accurate records of many patients who have been well and leading useful lives for more than 5 years since treatment, some of them for as long as 20 years or more. This committee has also presented facts that have saved many limbs by showing more accurate methods of diagnosis. Many cases that were considered cancer are now shown not to be such, and limbs are saved that would formerly have been sacrificed.

Another committee has been working on a comparative study of the results of treating cancer in other parts of the body by different methods—surgery, X-ray, and radium—and has collected thousands of records of such cases from all over the country. It has been definitely shown that the earlier the cancer is recognized the greater the chance of successful treatment, and this in cancer of some parts of the body may be much over 50 per cent.

In organizing a campaign against such a disease as cancer, a campaign that will be led by an organization whose membership embraces nearly 10,000 qualified, scientific surgeons, careful planning is necessary in order to prevent waste of efforts and to accomplish the most benefit. Co-operation with other organizations has been and will be carried on. Our present work which will be elaborated later, as more funds become available, now includes the following program:

1. Education of the public to seek early diagnosis. This can be done only by having routine annual physical examinations by qualified scientific doctors, for unfortunately cancer does not in its early stages produce symptoms that attract the attention of the patient. And it is in this early stage that a reasonable hope of cure can be entertained. The American College of Surgeons through its public meetings held in many parts of this continent each year teaches many thousands of people and tells them real cancer facts.

2. Organization of the medical profession so that it may utilize the best known methods of prevention and treatment of the disease. At our present Congress much time is being devoted by the leading cancer specialists of the country to a discussion of the methods that have been elaborated for the organization and administration of cancer clinics in general hospitals under the supervision of the College, to the end that every individual in the country may have made easily available to him or her the advantages of all that is known regarding the prevention and treatment of cancer.

3. Investigation of alleged cures for cancer which seem to show a sufficient scientific basis to justify the interest of the College in them.

4. A continuous study and analysis of the records of large numbers of cancer cases. Fellows of the College and other surgeons, pathologists, and radiologists are constantly sending, to the Department of Clinical Research of the College, records of the examination and treatment of cancer cases by different methods. The whole continent thus forms one laboratory. This co-operative study and the pooling of results of the work of the men who come into everyday contact with the patients is leading to a much greater knowledge of cancer facts.

In conclusion, let me say that organized scientific medicine is using every known means to combat the terrific cancer mortality, but these efforts will avail little until the time comes when the public will realize that the problem is theirs more than the doctors', and will seek periodic health examinations at short intervals, so that many conditions that would lead to cancer may be eliminated and cancer be caught in its early stages and be successfully treated.

CONSERVATION OF HUMAN LIFE AND LIMB FOLLOWING ACCIDENTAL INJURIES: HOW CAN THE AMERICAN COLLEGE OF SURGEONS AID IN THE PREVENTION OF THIS ENORMOUS HUMAN WASTAGE?

FREDERIC A. BESLEY, M.D., F.A.C.S., Waukegan, Illinois: It is not necessary to state to you, that this is a mechanical age, with its ever-increasing toll of human life and limb from accidents occurring on the highways, in industrial plants, on the farm, on railroads, and in airplanes.

The title "Conservation of Human Life and Limb Following Accidental Injuries and How Can the American College of Surgeons Aid in the Prevention of the Enormous Human Wastage Due to Accidents" expresses the theme and the brief of this discussion.

The splendid accomplishment of the National Safety Council in preventing accidents is well recognized and their slogan, "Safety First," has saved countless lives. The medical and surgical profession, in their effort to minimize the disastrous results of accidents, propose the slogan of "Safety Afterwards." How few of you realize the importance of this thought! Standardized hospitals and the most skilful surgical attention are necessary in making this slogan, "Safety Afterwards," come true. During the past three decades the advancement in surgery as applied to the treatment of appendicitis, gall stones, goiters, and many other human ailments has surpassed the fondest hopes and the greatest expectations of the older medical men. The saving of life and the prevention of untold suffering through this advancement in surgery cannot be estimated or overstated.

Unfortunately, achievements for the betterment of surgery as applied to the injured has not kept pace with surgery as applied to the conditions of disease, and it is proposed to exert every effort and stimulate every activity to improve this situation as it relates to the unfortunate who is injured so that the slogan, "Safety Afterwards," may be realized. Last year over 30,000 lost their lives in automobile accidents and another 20,000 lost their lives in industrial accidents and several millions were injured. The problem of surgeons and their organizations is the care of the millions that are injured each year who require the most competent and skilful service to restore them to health and usefulness.

Associated in this problem are the questions of transportation, hospitalization in Class A hospitals, and competent care of the injured by qualified surgeons. These questions can be answered and the problems solved only when and if the laity are educated and advised in the choice of their surgeons and their hospitals, and their intelligent co-operation is secured in this selection. You must be aroused.

1. Better roads and comfortable auto ambulances have greatly improved the ease with which injured patients can be transported, and it can be stated with truth and positiveness that it is far better to convey a patient many miles to secure a standardized hospital and a competent surgeon than it is to put up with an inadequate hospital and an incompetent surgeon near at hand. Remember that the World War taught this lesson.

2. The American College of Surgeons has and will continue to exert every influence and apply every known agency in elevating the standard of hospitals where the injured may be adequately cared for. They have carried on this work for fifteen years at a cost of nearly $1,000,000, paid for by surgeons.

3. A systematic effort is being made to improve medical education so that every medical graduate will be competent to treat the injured in the most scientific and accepted manner. This large surgical organization believes that it is its unalterable duty and plain obligation to elevate the standard of service rendered by hospital and surgeon to the injured and to go on forever and ever advancing in its surgical skill.

On your part there is an obligation and a responsibility. It is your duty to give careful consideration and intelligent thought to the kind of a hospital you are being taken to and the qualifications of the surgeon that is being called to treat you. Exercise as much thought and judgment in the selection of your surgeon and hospital as you would in the choice of your automobile. In this way make the slogan, "Safety Afterwards," a reality to you.

THE CRIPPLED CHILD

FREDERIC J. COTTON, M.D., F.A.C.S., Boston: The crippled child makes instant appeal to all of us. In later years, life and the stress of work cripple many of us. Some of us cripple ourselves. But that from birth or early infancy these little ones should be handicapped in the struggle to make something of life seems peculiarly cruel and unfair.

Anciently, such handicap was accepted as the will of God; in some countries, even today, as a sign of His displeasure, and until lately even with us, some measure of this acceptance has remained.

Not so many years ago, the state of New Hampshire took up the problem of the salvage of these cripples—a work, by the way, productive of immense good in this case—and there were found, in the back hill towns, an incredible number of crippled children, utterly neglected.

All over the country, public or private agencies have in the last generation attempted to deal with this very serious problem, and a vast deal of good work has been accomplished.

Little as one may like an approach to state medicine, it is obvious that much of this work can not be done effectively save by the state or by charity.

For instance, the wonderful work of the Harvard Infantile Paralysis Commission, monument to the insight and devotion of Dr. Robert W. Lovett, could not have been done save by collective effort.

Work of this sort is being done today very wonderfully in many countries. One need only cite the admirable hospitals supported by the Shriners in many cities.

No doubt this sort of work which we may call the surgical and medical salvage of handicapped children is going to be carried on increasingly well in the future. I have no doubt of that, now that our consciences are aroused.

But, individualist, as one of Maine Yankee and Scotch blood must be, I can not quite accept the institutional character of such work in full. From the hospital end the work must be institutional to be effective, within economic possibilities.

What I am thinking of is the individual end, the child himself. Is there not danger that in dealing with the problem of the crippled child, we fall in love with the problem and forget the child?

In my youth I grew up with several technical cripples who rose superior to handicaps, were as good as any of us, sometimes better. Among my later associates were others, handicapped heavily, some of them, but refusing to admit it.

One of them today, despite a ruined hip, is probably the best pathologist in the country. I have played tennis and swum with him and never heard a word from him as to his handicap.

Another, with double congenital dislocation of the hip, did his traveling on a bicycle in the main, became a marvelous trick rider, and incidentally, was the best doctor in his community for many years. And so it goes with half a dozen more.

Only lately I was much impressed when, at a consultation, the dean and the best of our orthopedists, in talking to a woman who was whining because of the inconvenience of a rigid hip, smiled and said that he had put up with that inconvenience for many years. I have known him 30 years, worked and played with him, and never before did I hear even an allusion to the fact that he was as crippled as many of the children who are segregated in institutions.

My work is essentially private, not institutional, and my relation to such excellent institutions as the Canton Hospital School, the Peabody Home, the School for Crippled Children, in my home town, has been very often in an effort to keep children out of them.

We must realize, I think, that our crippled children must be divided, distinctly, into two classes: the ones that must be tenderly cared for without much hope of result, the others who may, if we are wise and kind, be salvaged for active and useful and happy lives.

The type of person that is produced by, let us say, our Lakeville Tuberculosis place for children, the Widener Institution here, may be a surgical triumph and a testimonial to the kindest thought and care, but he doesn't fit, and seems generally not to have a very good time in life. It is at least certain that he does not fit.

What is to be done about it?

If I have anything to say to you, it is that our next effort after surgical salvage should be toward doing away with segregation, putting these little ones in an environment that means wholesome competition, not stress on what is due to one afflicted. Probably this means putting children

back into public schools when we can. Probably it means vocational schools in which the handicapped (within limits of their handicap as to what they can attempt) come into direct competition with normals,—and beat them out, just because, handicapped, they *mean to win*.

Many years ago, in Boston, there was a small newsboy in Pie Alley who had lost a leg. But he had one crutch and much spirit and developed a technique. Time and again I've seen him, on the curb, crutch under right arm, huge bundle of newspapers under the left.

Appearance of a possible customer. A yell and wild leap into the street, landing on the crutch, a stride onto the good foot, a swinging sweep of the crutch to dispose of competitors, and a sale.

That is the spirit I like and would like to see encouraged.

PLEASANT SURGERY

EDWARD MARTIN, M.D., F.A.C.S., Philadelphia: "How are you?" A daily meaningless salutation from many people and calling for such answers as "Fine," "Tip top," or if you be particularly wretched, "Fine and dandy." Of course you would love to tell each one how great your suffering, how martyr-like your bearing of it. But you are well aware that before you are fairly launched on your tale of woe you will be promptly interrupted by a voluble description of his or her sufferings as wearisome to you as yours would be to him or her. When it comes to ailments, the whole world is egocentric. The sick man, real or imaginary, cares for nobody, no, not he; and nobody cares for him, nobody, save a few near and dear ones, cares to see him, still less to hear him. With one exception—the surgeon. When he says "How are you?" he means it. He wants to know how you are, how your children are, how your parents and grandparents are or were. He listens patiently and with keen and intelligent interest to your complete tale of woe. This is the beginning of pleasant surgery. Further, he makes a gentle, skilful, complete examination, reassuring you on many points bearing on the working of your inwards concerning which you have had grave doubts. This is a continuation of pleasant surgery.

With conviction based on deep knowledge and wide experience, he may tell you that the underlying cause of certain symptoms which you have interpreted as insuring a speedy crippling or painful death are entirely remediable without resort to the knife.

This is the very quintessence of pleasant surgery. There are some thousands of people in this country who will die within the year because they do not know that surgery is pleasant. Examination may show a condition which can be remedied only by operative procedure but this can be made painless; the days after operation can be made painless. This being so, and the end in view, that is, the remedying of deformity, the restoring of function, or often the saving of life, being accomplished it is eminently proper to continue speaking of pleasant surgery.

Some hundred thousand people in this great land are daily harassed and nightly haunted by the fear of an incurable malady, cancer, for instance. Dreading corroboration of their fear, they suffer in silence; they age and weaken and become dependent and even die because of this fear. To such and to many others let the fact be known that surgery is safe and most efficient in the beginning of things, that surgery is painless, that surgery is pleasant, that its one and only unpleasant feature is fear, which surgery dispels. Therefore, if you fear cancer or any other malady go to the surgeon and have your fears dispelled; and if there be a condition threatening your health or life have it remedied by pleasant surgery, thus driving out fear.

WHO IS YOUR FAMILY DOCTOR?

IRVIN ABELL, M.D., F.A.C.S., Louisville, Kentucky: Who is your family doctor?

There are, doubtless, many in my audience today who, in answer to this query, would reply that they had none. In the few minutes at my disposal it shall be my aim to convince them of the wisdom of selecting a family physician upon whose judgment and skill the life and health of themselves or their loved ones may at some time depend.

The public in this country is rapidly becoming health conscious and there is general agreement that physical and mental health are a nation's greatest asset, since the prosperity and happiness of the people are largely dependent upon mental and physical vigor. Knowledge concerning the cure of illness, the preservation of health, and the prevention of disease is possessed only by those whose years of education, training, and experience have been devoted to the science and art of medicine.

The medical graduate of today brings to you a training in scientific methods with corollaries of accuracy in observation, interpretation of evidence, and judgment in conclusions, so necessary to the successful treatment of acute illness. He conveys to you the accumulated knowledge of the medical world upon the particular measures

which may be of value to you in the preservation of your health and gives to you rich judgment regarding matters of personal hygiene which will aid you in avoiding the acquisition of disease.

He is perfectly competent to take care of 85 per cent of the illnesses to which you are liable, and for the 15 per cent in which you will need additional study and treatment he will refer you to hospitals, laboratories, or consultants who are known to be expert and reliable. An age-old adage advises us to prepare for war during times of peace. The wisdom underlying this injunction applies very forcibly to the selection of a family doctor. One possessing both the science and the humanities of medicine enjoys a happy combination and is destined to be a source of comfort and help during the periods of illness which must inevitably come to each and every one of us.

There is at all times an average of 2 per cent of our population incapacitated, and about twice that percentage are impaired and handicapped by illness. The financial loss to the country represented by lost earning power and reduced production totals well over two billions of dollars a year, equivalent to one half the cost of maintaining the national government.

The economic features associated with preventable disease and premature deaths represent a huge and an utterly useless waste. Defects unknown to you, or if recognized by you and thought to be inconsequential, may in the course of a few years result in crippling the heart, in blood vessel or kidney disease—degenerations, in many instances preventable, which destroy your life or your efficiency at a time when you are most valuable to your family and your community. So, by all means have a family doctor; and may I advise with equal emphasis that you use him? Do not reserve his services only for acute illnesses that confine you to bed. From time to time have him make an audit of your health. Your banker does this for your checking account once a month; to continue checking against your account without a knowledge of your reserve or surplus would mean financial ruin.

In like manner injudicious expenditure of physical strength and reserve, together with the advent of insidious and unsuspected disease, in the absence of health audits, entails physical ruin. Your banker knows the condition of your finances and matters pertaining to your business, upon which knowledge he can give you reliable, trustworthy advice and assistance in maintaining financial soundness and fitness. Granting that you have a family doctor, he knows your temperament, the environment and conditions under which you live, your physical characteristics and reactions and he has a sympathetic understanding of your problems, collective knowledge, which is invaluable not only in carrying you safely through the crises of illness but in keeping you physically fit and sound by thwarting or minimizing the encroachment of disease.

POSTURE AND HEALTH

PHILIP H. KREUSCHER, M.D., F.A.C.S., Vice-President, American College of Surgeons, Chicago: Since his creation man has assumed the upright or erect position of his body as the normal attitude for activity. This position we speak of as "posture." The sitting or standing posture may be altered for a short time without any harmful effect upon the mechanism of the body. However, when a faulty or unnatural position is continued over a long period of time, it is natural to assume that health and usefulness will be greatly impaired.

Habit, custom, and disease are three factors which produce faulty posture and ultimately a greater or lesser physical incapacity.

Physical examination of a large number of young men and women has shown that 25 per cent of these persons had poor or faulty posture, 58 per cent fair body position and only 17 per cent held their bodies in a perfectly normal posture. The great majority of these were habit deformites.

Style and custom have decreed especially among young women that certain abnormal articles of clothing and footwear be worn with the result that postural deformities occur which are productive of impaired health. In the young the framework of the body lends itself to bad positions so that the shoulders become stooped, the spine curves and twists unnaturally, and the pelvic and shoulder girdles lose their normal alignments. All of these are due to faulty habit and custom postures. Fortunately these conditions are not so difficult to rectify.

When disease attacks the integrity of the human skeleton and deformities result, the general health of the patient becomes undermined. It follows then that if we hope to maintain our health and strength, good posture is one of the most important requisites.

How can a good postural attitude be maintained and how can faulty positions of the body be remedied?

The solution of this problem lies in the education of the child. Education must begin in our schools. A child sitting for hours each day in a stooped or cramped position at the desk will soon

become round shouldered, one shoulder remains higher than the other and often curvature of the spine results. This may lead to impaired breathing, disturbed heart action, and faulty digestion. The teacher must insist that the child have a suitable desk, and take regularly proper exercises outdoors and in the gymnasium.

The parent must supervise the child at home. Wearing apparel which interferes with the normal growth and development of the body must be prohibited. Improper footwear eventually interferes with normal gait and posture. The careless postural habits of the present day "flapper" make for poor and faulty body development.

A nationwide movement for the development of the body of the youth which encourages out-of-door life, calisthenics, swimming, riding, fencing, and in fact all athletic activities practiced with reason would do much in the prevention of deformities and resultant invalidism.

Regular, careful physical examinations of all children and young adults as recommended by the American College of Surgeons will reveal the very earliest signs of faulty body positions. When deformity exists proper treatment may at once be instituted before the faulty posture becomes fixed.

Immunization of the child against such illnesses as may bring about deformities is reasonable and all together justifiable. When disease has caused deformed spines and extremities, rational corrective measures must be applied. Corrective exercises under the supervision of a competent person must be instituted. In the more advanced postural defects the application of suitable appliances and braces in the hands of trained physicians will accomplish much more than treatments given by untrained, unskilled, and often unscrupulous individuals.

With the knowledge that good posture makes for good health, that bad posture often undermines the health of the individual, it behooves us all to make every effort to prevent deformities, and when impairment of body functions has occurred to do our utmost to correct it.

WHAT SCIENTIFIC MEDICINE IS DOING FOR THE PROSPECTIVE MOTHER

JOHN OSBORN POLAK, M.D., F.A.C.S., Brooklyn, New York: Childbearing is an obligation which the woman has to the state. The healthy mother is an economic asset. Scientific medicine is making its contribution to the health and happiness of the prospective mother by teaching her the hygiene of pregnancy and the way to have a healthier and happier baby, for scientific medicine saves the baby.

While pregnancy and labor are physiological acts, they have become complicated by our civilization, inter-current disease and inter-marriage. These conditions may result in complications, accidents, emergencies, and difficult labor.

To be forewarned is to be forearmed; routine prenatal care forewarns. This care includes a complete physical examination of the woman, for childbearing is a strain and her organs must be normal or approximately normal to withstand it. Every pregnant woman should consult her physician early in its course. She should have her blood pressure taken at monthly and later at weekly intervals, her urinary output estimated, her urine examined, and her weight recorded. Symptoms of headache, nausea, and bleeding are danger signals. Rise in blood pressure is dangerous and rapid increase of weight is serious; both are forerunners of toxic poisoning. Kidney function is an index of elimination. Water flushes the kidneys and carries off waste.

Babies should not be allowed to grow too large, —small babies make labor easier, and they grow faster than large babies after delivery. Scientific medicine can accurately determine the size of the baby, as well as the size of the bones through which the baby must pass, and thus save the mother from tedious and dangerous labor.

Scientific medicine can diminish the incidence of stillbirths by the recognition of the presence of poisons in the blood. Each prospective mother should have her blood examined that the unborn child may be free from taint.

Proper food, rest, hygiene, and exercise are necessary for health. The right kind and amount of liquids and food are necessary to keep the skin, kidneys, and bowels in order to prevent overworking of the organs of the body, to provide strength for the mother and the baby, and to prepare the mother for nursing the baby. The following rules of health should be memorized by every expectant mother:

1. Eat wisely and well of a mixed diet with plenty of fruits, vegetables, and milk.
2. Drink fluids freely, 8 or 10 glasses of fluid should be taken every day.
3. Keep the bowels open.
4. Bathe daily in warm water.
5. Wear clothing that is warm enough and yet comfortable.
6. Get as much fresh air and sunshine as possible, keep the house well ventilated.
7. Take plenty of careful outdoor exercise.
8. Get plenty of rest and sleep; always rest after luncheon.
9. Keep contented and happy.

10. Take care of the teeth and the hair.
11. Take care of the breasts and nipples, wear a brassiere.
12. Watch your weight.

THE TRAGEDY OF APPENDICITIS

HUBERT A. ROYSTER, M.D., F.A.C.S., Raleigh, North Carolina: "Is it time to stop talking about appendicitis? No! It is just the time to begin talking about appendicitis, and talking most seriously and emphatically about it." Thus spoke John B. Murphy fifteen years ago. The need for such a challenge is every bit as compelling today as it was in 1915. In spite of all our efforts, appendicitis kills four times as many people before the age of 50 as does cancer.

While some individual surgeons are reporting a low death rate, the general opinion over the whole country seems to show that the death rate is increasing. If this is true, and it can hardly be disproved, the proper question arises, who is to blame? When the disease is confined to the appendix itself, the death rate from operation is practically zero. It is the complications that kill, and the conditions leading to these complications in most cases are the delay in operating and the taking of laxatives. Gangrene of the appendix or bursting of the appendix are the two dangerous complications. The first is due to delay and the second to laxatives. There is pressing need to remind everybody that delay in the beginning of acute appendicitis is still the deadly sin. In these favored times this appears extraordinary and may sound strange, but it is not beside the mark, even in our larger civilized centers. There are some who are still waiting for the acute attack to pass off before advising operation, even allowing the appendix to burst before their very eyes.

Still abroad in the land is a lingering fancy that there is such a thing as medical treatment of appendicitis. The very worst feature of this idea is the giving of purgatives in the acute stage with the false notion of driving out of the intestinal canal something or other which has no relation whatever to the disease. This fallacy constitutes the second deadly sin—purgation. It may be fatal to give any form of purgative at any time in any abdominal pain. This just as surely causes a blow-out as would happen to a thin rubber tube when stretched beyond its capacity.

Further enlightenment of the laity upon appendicitis is imperatively demanded. Foremost in the cause should come the physician and to his aid must follow boards of health, civic organizations, schools, nurses, and druggists. If an annual Cancer Week and periodic health examinations and tuberculosis clinics, why not an Appendicitis Week? People must be shown that in appendicitis the "attack" is not the disease, but only the knock at the door; that appendicitis is a continuing process, a going concern, always existing before the attack comes; that one attack does not protect, but that in 98 per cent of the cases it means others to follow. The city of Philadelphia, through its health department, has shown commendable zeal in proposing a campaign to reduce the high death rate in acute appendicitis. Bulletins published here show that there was an increase of 18 per cent in the death rate of appendicitis in Philadelphia between the years 1913 and 1923 and that laxatives given to patients with abdominal pain before they reached the hospital were responsible for 207 deaths. In addition, attention is called to the estimate that in 1926, 17,000 people in the United States died of appendicitis; 12,000 of these were given laxatives, and of this number 11,000 probably died from laxatives.

The danger of delay is also stressed in another bulletin which shows that between those who lived and those who died there was more than 70 per cent increase in lapse of time between the beginning of the disease and the operation. It would be interesting to know further how many cases of appendicitis died without being operated on. In the so-called clean cases of appendicitis, almost any surgeon can show a record of no deaths. The whole matter, then, is to have the appendix removed before it becomes gangrenous and before it ruptures and to remember that the causes of these complications are practically always due to procrastination and purgatives, twin factors of fatality in appendicitis.

In conclusion, let us summarize the salient points:

1. There is no medical treatment of appendicitis.
2. There is a crying need to remind both the medical profession and the laity that delay in the beginning of acute appendicitis is still the unpardonable sin; that the administration of laxatives in any form is the explosive blast that wrecks the works; that once appendicitis, always appendicitis, until the little assassin is removed.
3. Instruction of the laity and renewed concern of the physician, chiefly upon the dangers of delay and the giving of laxatives, is demanded.
4. Whenever gangrene or bursting of the appendix occurs someone has blundered.
5. The tragedy of appendicitis is that even one human being should die of the disease.

GOLF AND HEALTH

HENRY WADE, C.M.G., D.S.O., F.R.C.S., Edinburgh, Scotland: Good afternoon, ladies and gentlemen! I am here from Scotland to speak to you for five minutes on golf and health. Scotland, as you know, is the birthplace of the game. It is a wee country situated at the northern end of Great Britain. It is ruled by George V and is famed throughout the world for its oatmeal; its native beverage, whiskey; Harry Lauder; and golf.

Speaking of Harry Lauder and whiskey reminds me of the Scot who went away for a week-end golfing holiday which, unfortunately, was spoiled as he lost his entire luggage—the cork came out!

To return to Scotland. In its long and turbulent history it has suffered many invasions by Romans, Angles, Saxons, Scots, Danes, and Normans, but it was never completely conquered until the recent American invasion headed by Robert Jones. Their victories were achieved on the golf courses of Muirfield and Prestwick and St. Andrews, but their final conquests were achieved in the hearts of the people of my native land, which citadel they have carried by storm and will hold for all time.

But what about golf and health? The game, you know, is unique among sports in that it can be played at any age of life. Tommy and his grandfather can play a foursome match with daddy and his grandfather and carry the game to the home green, leaving the three senior members to settle the match at the nineteenth hold in the club house.

The health to be gained by the exercise on the links is not only an improved physical well-being, but also a perfect training in mental equilibrium so valuable in everyday life. It teaches control of the temper.

The links in Scotland are given over every Monday forenoon to the ministers of religion, that being their day of rest. Recently, a pre-eminent Edinburgh divine was playing at St. Andrews and was off his game and finally his golf ball came to permanent rest in Hell's bunker, or trap. Throwing away his clubs, he shouted to his caddy, "I'll have to give up the ministry." Another occupant of the same bunker, having failed to get out in spite of many explosive shots and explosive ejaculations, and having tried every club in his armamentarium, turned in dismay to his caddy who was sitting dangling his legs over the edge of the bunker and asked him in despair, "What more can I do?"

"Hae dad a' it wi' the bag," advised the caddy. ("Hit it with the bag.")

Golf is also pre-eminent among healthful outdoor games in that it can be played in any climate and at any season of the year. It is not, like many others, only a summer game. In Scotland this is unfortunate as this year we had our summer on a Sunday.

Which reminds me that we have now in Scotland a number of places where Sunday golf is now obtainable. In some of these, which are private courses, you can get the assistance of a caddy. In others, you have to be your own caddy and in the last, which are public courses, and have had the flag pins removed, you may have to play your approach shot on to the green with the hole marked by your partner's Sunday hat placed on top of his wife's Sunday umbrella.

Yes, it is quite a good game. Which reminds me of what Andrew Kirkcaldy had to say on the subject of Sunday golf. "If the golfers do not need a rest on a Sunday, the greens do."

Now as regards miniature golf. What is to be said of it? I am referring to Andrew Kirkcaldy again who was once playing in a tournament over the Braid hills in Edinburgh and for once the sun was shining and it was a warm day. As he mopped his forehead, climbing up one of the hills leading to the green on the top, he was heard to mutter, "I'm a gowfer, no' a—goat!" So with miniature golf. Its tricks far excel those of the most marvelous conjurer, but as a health-giving exercise, it is best for the proprietor who is not on the premises, but out at his country club playing golf in the fresh air this glorious afternoon.

The five minutes are up, ladies and gentlemen. May I wish you all, and especially my fellow countrymen, a braw, bricht moonlicht nicht, victory over old man Bogey, and finally afterward a good "doch in doris."

SAVE YOUR EYES

EDWARD JACKSON, M.D., F.A.C.S., Denver: Save your eyes! You have only one pair, and two eyes are better than one, even if one is very poor. Half the blind people in the country are over 58 years of age, and most of them have lost their sight by years of abuse of their eyes. Don't go near the danger line of blindness by straining them. Good light helps, whether your eyes are good, or bad. If you need glasses nothing else can take their place. When glasses are on, they keep particles in the air from striking your eyes. For many kinds of work, that is *safety first.*

Keep the eyes clean. Infections getting into the eyes cause loss of sight. Bootleg liquor is dangerous and wood alcohol mixed in it is very dangerous. Even tobacco may cause weak sight

if you smoke as much as ever when you grow older. Tuberculosis may destroy the sight in the young, and hardening of the arteries may do the same in the old. To keep your sight at its best and be able to do the most with it, you have to keep your *health good in every way*.

Most people get poor sight when they are old because they did not take care of it when they were young. As you grow old you have to depend more and more on your eyes for your work and your recreation. When you can no longer do hard labor, or walk much, or join in out-door sports, your eyes may give you the only occupation possible. Do not throw away the chance of good sight to old age when a little care might save it. The usefulness and pleasure of life both depend on it. Many who think they would rather be dead than blind have become blind, because they did not think of the value of good sight soon enough.

Most of us have good health to start with, the most valuable thing we can inherit. Good sight is a very important part of health. The way to keep it is to think ahead about how much it is worth keeping. If we do that, it grows more valuable as we get older, as much as savings in a good bank or investment. Medicine and surgery used to try to repair damage that had been done. Today they are more and more concerned in preventing diseases and injuries. The great heroes of our time are men like Gorgas, who made the Canal zone the most healthful part of North America, whose greatest monument is the institute, bearing his name, for the study and teaching of health; or Noguchi who gave his life in the struggle to prevent yellow fever.

Your eyes are the part of your body in which you can best watch your health and really see results from taking care of it.

PREVENTION OF COLDS

ALTON OCHSNER, M.D., F.A.C.S., New Orleans: The common cold is the most frequent infection to which the human race is susceptible. Fortunately, most colds are of little significance aside from the inconvenience to and the decrease in the efficiency of the affected person. Everyone is aware of the fact that during the course of a cold one's usefulness and efficiency are definitely decreased. A cold, therefore, is of economic importance. However, many of these infections are much more serious in that they are forerunners of bronchitis and pneumonia. In this respect colds become a menace not only to the health but also to the life of the individual.

Unfortunately, relatively little is known concerning the causes of colds. That a cold is an infection is definitely known, but instead of its being an infection which is caused only by one germ it is probably the result of many germs. The severity of a cold is largely dependent upon two factors: the type of germ which is responsible for the infection, and the resistance of the individual. In any infection, a fight or battle rages between the offensive germs and the defensive mechanism of the body. The result of the battle depends upon the relative strengths of the two forces. Many of the germs which are responsible for colds are found normally in the nose, mouth, and throat, of healthy individuals. These individuals have no symptoms nor do they present any evidences of a cold. However, if the defensive force of the body can not prevent the advance guard of the germs from gaining a foothold as a result of lowering the resistance of the body or of increasing the number of the offending germs, a cold results.

The defensive reaction of the body is diminished by certain conditions; namely, exposure, chilling, fatigue, and over-indulgence. As an army is less capable of resisting the enemy when fatigued so is also the body. Exposure to cold and chilling are important exciting factors in the production of colds, whereas chilling of a part of the body favors the development of the cold; chilling of the feet is especially important. It is a well-known fact that damp or wet footwear in cold weather is especially apt to cause colds. This is because the layer of air which normally acts as an insulator between the foot, hose, and shoe when the footwear is dry has become replaced by moisture which conducts cold much more readily. Over-indulgence of any kind places an added strain on the resources of the body and thus diminishes the resistance of the individual to any attack.

Of paramount importance in the prevention of colds is the limitation in the number of offensive germs. The number of germs present in the body may be materially and dangerously increased by large numbers being introduced from the outside; i.e., from other individuals suffering from colds. Colds can be and commonly are transmitted from one individual to another. Not only must the cold germs be transmitted from one individual to another, but the strength of these transmitted germs is apparently enhanced each time they are transmitted.

In summary it may be said that colds can be largely prevented by:

1. Regular habits of life especially as regards eating and sleeping.
2. Avoidance of undue fatigue.

3. Dressing warmly in cold weather and avoiding chilling of the body, especially the feet. The wearing of damp footwear predisposes to colds.
4. Moderation in eating and drinking.
5. Avoidance of large crowds, especially at those times when colds are prevalent.
6. Avoidance of contact with people with colds.

THE TALKING PICTURE IN MEDICAL EDUCATION

PHILEMON E. TRUESDALE, M.D., F.A.C.S., Fall River, Massachusetts: The 21,000 theaters of the United States have clearly demonstrated to the public the amusement and entertainment features of the talking picture. That the principle applied in theatrical productions would find adaptation in the educational field at an early date seemed certain.

Since life is synonymous with motion and all the organs of the body are in a state of constant activity, physicians everywhere were quick to realize the vast possibilities of motion photography in the study of the human body in health and disease.

Then, too, the doctor is essentially a teacher. To him the talking picture appears to have introduced a new and impressive method of imparting medical knowledge. Only a little more than a year after the talkies appeared in theaters the American College of Surgeons at its Clinical Congress, held in Chicago, October 1929, demonstrated the medical talking picture before the surgeons of this country and Canada for the first time. While these talking pictures fell short of perfection in many respects, the encouragement and friendly co-operation of the directors of the College in stimulating authors to renewed effort has given this great American institution a pioneer position in promoting the adoption of this modern scientific agency in medical education.

The talking medical picture will have a vast field of usefulness in the practice of preventive medicine and teaching of hygiene. For example, the exact manner in which the hookworm imbeds itself in the child's foot through a small crack in the skin, portrayed by motion pictures and voice description, would carry a lesson to the public in a striking manner.

Would it not be infinitely more effective to teach hygiene by actual demonstrations in a well planned talking motion picture than by lecture and still pictures? The film with sound will find an important place in teaching first aid. In industry the prevention of accidents can be taught best by motion picture and description of dangerous pieces of machinery in action and the manner in which the unwary employee gets entangled. The American Telephone and Telegraph Company and many other large public service corporations have organized first aid teams. To them a two reel talking picture illustrating various forms of accidents, their causes, mechanism, form, and treatment would possess great educational value.

In a talking motion picture the correct emergency method of applying splints for broken bones could be well presented, also the treatment of burns, the control of bleeding, the proper method of doing artificial respiration for drowning, and the handling of individuals suffering from electrical shock.

Before the talking film, the student can see, hear, understand, and remember.

Finally, the talking motion picture will have much in store in the form of educational advantages for the family physician. In his struggle to keep informed on recent advances in medical knowledge he is faced with a problem difficult to solve. By the cost of travel and that intangible, but nevertheless appreciable loss in clientele entailed by absence from his community, the doctor's continuation schooling is reduced to medical books and journals.

In the light of such developments in modern science as the sound film, it is likely that certain relationships between teachers and students of medicine will be modified.

Lectures and demonstrations recorded on films will be made available to doctors wherever located, in city, town, or backwoods. Instead of the student appearing before the teacher in the amphitheater or in the laboratory, the teacher in his amphitheater or in his laboratory will appear on the film before the doctor at a society meeting, a hospital staff conference, or, it may be, in the doctor's own library.

Indeed, a look into the future cannot fail to excite inspiration over the inherent possibilities of this new relationship in science, art, and electricity in the field of medical education.

CHOOSING YOUR HOSPITAL

MALCOLM T. MACEACHERN, M.D., C.M., D.Sc., Associate Director, and Director of Hospital Activities of the American College of Surgeons, Chicago: Today everybody wants to live as long as he can, not only for the traditional three score years and ten but even up to the century mark. There is so much doing in this grand old world that none of us wants to leave it. Therefore, *keeping* well and *getting* well are of vital importance. This afternoon I am going to speak to you particularly about *getting* well.

You know we have organizations that are doing fine work testing foods to determine which brands are safe to eat, and we have other organizations testing mechanical equipment to learn if it is safe for human use. But do you realize that the American College of Surgeons, a great organization of surgeons, tests hospitals to determine which ones are safe places in which to get well? Each year at this time the American College of Surgeons publishes a list of such institutions which it has approved, and from these you may choose your hospital with perfect confidence. Today such a list of 2,063 approved hospitals will be published in all the leading newspapers of the United States and Canada.

Thirteen years ago this association, now comprising approximately 10,000 of the leading surgeons in the United States and Canada, inaugurated the hospital standardization movement for the purpose of encouraging, assisting, and guiding hospitals to meet certain definite requirements for good care of patients. At that time only 89 hospitals of the United States and Canada could measure up to the requirements. This number has now increased amazingly to 65.2 per cent of all hospitals caring for acute conditions and having 25 or more beds. What is more, it appears as if the hospitals in the group of 100 beds or over will soon be 100 per cent approved, as 93 per cent of them are on the approved list announced today.

Nor is this mere paper approval. It is granted only after actual survey or inspection of the hospital by a specialist in this work, and on other information at hand which assures the American College of Surgeons that the institution is living up to the requirements. Because a hospital is once approved does not mean it can continue to live on its reputation. It is re-surveyed each year, and if it falls short in meeting the requirements, the approved rating is taken away. All this work of personal surveys of over 3,000 institutions is done by experts at no expense to the individual hospitals. The cost is borne by the American College of Surgeons which has undertaken the mammoth task solely for your protection and benefit. Already the members of this organization have contributed almost a million dollars out of their own pockets for the betterment of hospital care of patients.

Just how does the approved hospital differ from the old fashioned, unsupervised one of former days? The former must fulfill a number of definite requirements of which the following are the more important:

1. The hospital must be properly equipped for the comfort and safety of the patient and have proper facilities and the right type of personnel to assist the doctor in finding out what is wrong with the patient and in applying the best treatment known to scientific medicine.

2. There must be a well organized medical staff of ethical, competent doctors, all graduates of recognized medical schools. These thoroughly qualified doctors must also sign a pledge not to engage in fee-splitting, a pernicious and inhumane practice of giving or accepting commissions for patients referred. This leads to unnecessary and incompetent surgery for which the patient suffers ultimately.

3. Case records are required which give a complete history of the patient's illness—how it started, how it developed, what was found on examination, what treatment was carried out, and finally the results. This is absolutely essential for safe and efficient care today, because the doctor sees so many patients that he cannot carry all these facts in his mind. They must be recorded. The careful hospital insists on good case records.

4. The medical staff of the approved hospital must meet regularly to review or audit the professional work of the institution. Deaths, unimproved cases, complications, and all medical work not up to standard must be thoroughly discussed in group meetings. By this means any inefficiencies that exist are brought to light and can be remedied.

Not only is the medical care improved in the standardized hospital; nursing care, food, and all other services are carefully regulated according to definite standards so that the patient's stay will be as happy, comfortable, and beneficial as possible.

That this minimum standard for hospitals, as it is known, is working a truly remarkable improvement can be seen from the fact that the death rate has been reduced more than half in approved hospitals during the past 10 years. Risk in major surgical operations has been reduced to a minimum, methods of anæsthesia have greatly improved, and the treatment of cancer, goiter, fractures, and other serious conditions is vastly better. And think of this the next time you go to a hospital for treatment—the patient's average stay is only half as many days as it was 10 or 12 years ago.

How can I tell which hospitals are approved by the American College of Surgeons, you ask. Well, first of all there is the list of approved hospitals in your community which appears in the local daily papers this afternoon. Clip this out and refer to it when you have occasion to select a hospital. If you do not have a list, consult your

family doctor. He knows the approved hospitals in your community and will be glad to give you this information. Chances are he works in one or more of these. And, finally, there is the certificate of approval displayed near the admission desk of most hospitals on the approved list, just as your doctor has his certificate of degree framed and hanging in his office. A hospital must be on the approved list for at least 2 years before it receives the certificate of approval.

It is a pleasing and comforting feeling to know that when you are taken ill there are hospitals close at hand which have been surveyed and approved by the American College of Surgeons. But it is even a greater feeling of comfort and confidence to know that if you are taken ill while traveling and are without relatives or friends that you will always have a real friend in the approved hospital, an institution activated by the proper spirit of service, and where you will find the best doctors, nurses, and hospital workers to care for you and do everything possible to bring you back to normal health.

And now in closing let me urge you to have no fear of going to an approved hospital if necessary. Be assured every possible effort will be made to make you happy and comfortable, to alleviate your pain and suffering, and to bring you back to normal health in the shortest time and in the most comfortable manner. And remember, though hospitals are becoming increasingly scientific the humanitarian aspect is growing accordingly. The motto of the approved hospital is that ancient but still modern exhortation, "Do unto others as you would have them do unto you." This is why the hospital standardization movement has succeeded, because it is based entirely on the fundamental principles which assure the best care of the patient at all times.

THE HOSPITAL AND THE COMMUNITY

ROBERT JOLLY, Houston, Texas: This subject is a double-barreled one because the hospital and the community each have an equal responsibility to the other and you cannot discuss one without the other.

What is the community's responsibility to the hospital? An unthinking man remarked to me in Houston a few days ago that he felt no obligation to support the hospitals in his community since none of his family had ever needed a hospital and all of them were perfectly well at that time. I searched his mental recesses with these questions:

"Do you believe the city ought to maintain a fire department?"

"Have you ever had a fire at your house?"

"Is the fact that you never have had one any proof that you never will have one or that you will not have one within 15 minutes?"

Of course, his replies were in the negative.

I then said to him, "If it is necessary to maintain a fire department it is just as necessary to maintain hospitals, for while neither you nor any of your family have ever been patients in a hospital, any one or all of you may be patients before night."

He was converted right then and there.

The community does have a tremendous obligation to maintain a hospital or hospitals, according to the size of the population. There ought to be at least one hospital bed to every 200 inhabitants. The fact is, I think, that every county which has as many as 10,000 population ought to have a county hospital. Aside from the moral standpoint, a community ought to maintain hospital beds from an economic standpoint. Since it has been proved that the death rate is materially decreased when sick people are sent to a hospital, and that incapacitation is lessened with the result that they may be earning an income much sooner when they are cared for in a hospital than in the home, a community is under an obligation not only to supply beds for "free" patients, but also for "part-pay" patients and "full-pay" patients.

The fact is, it is cheaper to maintain a hospital by taxation than to leave hospitalization to churches and private individuals, for the taxation rate, being distributed among all the voters, becomes so small that no one individual can feel oppressed. When funds for a hospital have to be raised by solicitation naturally some people must contribute more than others. We tax people to maintain a pure water supply so as to keep them healthy. Is it not just as important to maintain an institution to heal them if they become sick or disabled?

But since so few communities have tax-supported hospitals, the people are under an obligation to maintain whatsoever kind of hospital is near them, whether it be a church hospital or a private one. Only last week in a Texas town of 5,000 people I talked to a doctor who had built a private hospital. Every emergency case naturally rushes to that hospital because it is the only one within 50 miles. The situation is about to ruin him financially because the county commissioners will not assist with funds and the public feel no obligation, and so this doctor is having to bear the burden of free hospitalization of his town of 5,000, plus the county. This is unfair to the man who must also give free medical care.

Now the hospital, regardless of whether it is tax supported or privately maintained has an obligation to the community which is five-fold: (1) to take care of the sick whether they are able to pay all, or part, or none of the bill; (2) to educate nurses; (3) to educate internes; (4) to provide research laboratory facilities which will constantly provide new protection for the health of the people; (5) to maintain health educational clinics where the people may be instructed in health preservation methods, diets, etc.

The hospitals of our country are, as a rule, doing their best to live up to their obligations and opportunities. Most of the 7,000 hospitals, even those maintained by taxation, are having a perennial struggle to meet the demands made upon them with the meager financial resources at their command.

Many people have an idea that hospitals are money-making propositions. My experience has been that most of them barely get by and the rest of them would have to close their doors were it not for the assistance which they receive from donations of different sorts. Of every dollar last year going to philanthropy, only 7 cents went to hospitals. Hospitals must be endowed if they are to care for the middle class and the pauper class. Instead of building monuments in the cemeteries and flag poles in the streets and other simply ornamental memorials the wealthy people of this nation must contribute their money to hospitals which will not only safeguard the health of the people but care for those who are sick and disabled 24 hours in the day and 365 days in every year. No finer monument can be erected to anybody's name than a hospital which is performing the five functions I have mentioned, and which never closes its doors. While the donor is asleep at night he has the satisfaction of knowing that his money is working for the good of mankind. A hundred years after the donor is dead and gone his name will live on and his influence will still be at work within and without the walls of the hospital to which he has contributed.

THE GORGAS MEMORIAL AND THE PERIODIC HEALTH AUDIT

REAR ADMIRAL CARY T. GRAYSON, M.C., U.S.N., (Retired), President, Gorgas Memorial Institute, Washington: Friends of the radio audience, I shall discuss briefly but one phase of the health educational program of the Gorgas Memorial Institute at Washington, D. C. The research phase of our work, which is being carried on so efficiently in the Gorgas Memorial Laboratory at Panama, will be described to you by Dr. Herbert C. Clark, Director of the Laboratory, whom you will hear in a few minutes.

As you may know, the Gorgas Memorial Institute is a national health organization, established by physicians, dentists, and laymen to conduct an intensive drive against unnecessary illness and premature death. It honors the life and work of General William Crawford Gorgas, pioneer in preventive medicine, whose fine genius in sanitation was one of the great factors in the building of the Panama Canal.

In 1914, as Surgeon General of the U. S. Army during the World War, Gorgas saw the value of his policy of strict physical examination of all recruits for military service, and it was his hope that ultimately this measure, the health audit, would be adopted by the general public as a means of prolonging life. After his death in 1920, his friends decided to make this dream of his come true, and a nation-wide campaign to educate the public in the value of the annual health audit was made one of the chief tasks of the Memorial to perpetuate his name. As a pioneer in this effort, the Memorial feels a satisfaction in the knowledge that an increasingly large number of people everywhere are appreciating that the periodic health audit means longer life, happier life, better life.

What is meant by an annual or periodic health audit? In reality it means a thorough "going over" of your body by your family doctor, a procedure that takes about an hour of your time once a year. This physical examination made by one who knows you and your family and is interested in your physical welfare determines how sound your health is and how it can be preserved and improved.

Why should you have a health audit? Because, though you are not sick, you may not be enjoying the fullness of health and vigor of which you are capable; because some diseases in their early stages give you no warning of their existence (cancer and Bright's disease are noteworthy examples of this fact); because a disease discovered early is the more likely to be cured quickly.

In past years it was considered necessary to seek medical advice only upon the appearance of some symptom which was sufficiently disturbing to the individual to cause him to seek his medical adviser. Today the term "patient" includes not only those who have disease but those who wish to avoid disease. I do not mean to imply that the periodic health audit will eradicate all disease. That man is mortal is an indisputable fact, and that he will continue to die is self-evident. If,

however, the medical profession was content to rest on this statement, progress in the science of medicine would cease. The increased span of life, which is now the heritage of every child born in this country, did not come about through any such complacent attitude toward disease. Today, members of the medical profession, looking ahead to better things for you, are not content to play the rôle of mere emergency men, to be called only when something breaks. They are not content only to make people well when asked to do so; they want the better job of keeping you well. In this they need your co-operation. They urge upon you the advice to consider seriously this new turn of health affairs, preventive medicine.

You friends out on the air, particularly you of middle age, do you know that out of every 100 of us, heart disease kills 23; apoplexy, 12; kidney trouble, 12; tuberculosis, 4; in other words, that 61 per cent of us die of preventable disease before our time?

It is a duty, which we owe ourselves, our dependents, and our country itself, to possess during our period of life as great a measure of health as may be possible. The Gorgas Memorial Institute feels that the annual health audit constitutes a most important factor in maintaining this highly desirable and efficient state of well-being.

Last year, as a part of our health educational program, 5,000 high school pupils made the periodic health audit the basis for a health essay in a nation-wide contest which we sponsored. This year, with plans for the third annual Gorgas Health essay contest well under way, several thousand more young people are going to learn all about the value of prevention of disease. The longevity of the grown-ups of tomorrow is pretty well assured, but today it is you and I who need to wake up and grasp the benefits of this health protection before it is too late.

In closing, may I tell you that I believe in the periodic health audit thoroughly, and I urge upon you to adopt it, if you have not already done so. I might make this suggestion for a new use for your birthday: designate it as your annual reminder of the fact that the periodic health audit means better personal health, longer life. This is the message of the Gorgas Memorial Institute, based on the life and work of a man whose courageous work in preventive medicine saved countless lives and millions of dollars.

MOSQUITO CONTROL

HERBERT C. CLARK, M.D., Director, Gorgas Memorial Laboratory, Panama, Republic of Panama: The mosquito problem in the early construction period of the Panama Canal was almost as serious as any of the engineering difficulties that beset the commission entrusted with the responsibility of constructing the Canal. Gorgas was the first to apply, on a large scale, in the tropics a successful method of mosquito control. His objectives were the control of those mosquitoes known to carry malaria and yellow fever. Ship quarantine methods assisted greatly in the control of yellow fever but the disease of greatest economic importance, then as well as now, in the coastal plains of the tropics was malaria.

Gorgas was confronted with the problem of protecting a labor and administrative force scattered throughout the middle of the Isthmus of Panama. He adjusted his campaign to fit available funds and, therefore, he exercised a shorter radius of mosquito control in construction days than our present period of time and experience finds in use. It was possible at the close of the construction period of the Panama Canal to reduce greatly the population and to concentrate it more or less at each terminus and thus greatly reduce the cost of sanitation and housing of the personnel.

The control of malaria is almost perfect within these sanitary areas but even now, 26 years after the start of the work, it is absolutely necessary to maintain and operate thoroughly these field sanitary methods because malaria exists outside of these zones in about the same incidence as it did in earlier years. Attention is called to this to impress the fact that sustained well directed efforts are required anywhere to control mosquitoes, either as a pest in northern climes or as a health hazard in the tropics. Permanent drainage of useless water surfaces, filling of such potential breeding areas that cannot be drained, or regular treatment of water surfaces that must be left undrained or unfilled are necessary. It is needless to mention that all artificial collections such as rooftop pools, barrels and buckets used as reservoirs, discarded tin cans, neglected troughs, etc., can breed countless numbers of mosquitoes of one species or another. Temperate climates with the severe winter season aid materially in this control of mosquito breeding as compared to the tropics, but in any clime the control of mosquitoes depends on a thoroughly sustained effort in charge of as permanent an organization as is held responsible for street cleaning and garbage disposal in a city or highway maintenance in the country. There is expense to mosquito control, but it pays when correctly carried out. We now have access

to sound advice in such matters from the United States Public Health Service, the Agricultural Department of the United States, many state health boards, the Rockefeller Foundation, and now, in addition, expert advice in mosquito control may be secured from the Gorgas Memorial Institute, Inc., 1331 G Street, Northwest, Washington, D. C.

HOSPITAL STANDARDIZATION

REPORT OF 1930 CONFERENCE IN PHILADELPHIA

AN abstract of the papers and discussions presented at the Hospital Standardization Conference held during the Clinical Congress of the American College of Surgeons in Philadelphia, October 13–17, 1930, is presented in the following pages. Surgeon-General Merritte W. Ireland, Washington, past-president of the College, presided.

OPENING ADDRESS

Surgeon General MERRITTE W. IRELAND, Washington: Had the hospital standardization movement not been begun 13 years ago it is quite conceivable that hospitals considered as a whole would be in a most chaotic state, for the phenomenal increase in number of institutions would certainly bring vast inequalities in the care which is rendered if there were no supervision or standards.

The most concrete example of progress is perhaps the increase in the number of approved hospitals. In 1918, only 89 hospitals in the United States and Canada could meet requirements for the necessary clinical records, clinical laboratories, and other facilities. The College might well believe in the face of such a poor showing that it had established too high standards, but it steadfastly refused to depart from its ideal, with the result that today nearly three-fourths of the hospitals of 25 beds and over are fully or conditionally approved. It is especially important to note that 93 per cent of the hospitals with 100 beds and over are approved, and that the record of the government hospitals is 100 per cent.

So pronounced is the better care in approved hospitals that the average days' stay has been shortened to approximately 12, a reduction of half the number of days spent in the hospital 13 years ago. Gross mortality for the year just ended averages 4 per cent, a figure that is not simply for the deaths occurring after 48 hours but the *total* deaths. Standardization has influenced every department so that the patient is protected through better surgery, better nursing, more scientific feeding, and better asepsis.

To improve clinical procedures and to promote economies in administration, it is important to keep careful statistical record of all hospital activities. An illustration is the standardization of surgical dressings effected by the Hospital Department of the College. By means of a study of the problem of surgical dressings, it has become possible to reduce the number of dressings from the 4,000 different kinds which were in use to 21 varieties.

Hospital standardization was originated primarily for the right care of the sick, but a valuable by-product has proved to be the better working conditions for hospital personnel.

PRESENTATION OF THE THIRTEENTH ANNUAL REPORT OF HOSPITAL STANDARDIZATION

FRANKLIN H. MARTIN, M.D., Chicago: The American College of Surgeons has continued its intensive survey of hospitals in the United States and Canada during 1929–1930. This year's work shows a list of 2,063 hospitals which meet or excel the minimum standard—a net gain of 94 approved institutions. The survey year after year is conducted with a view not only to increasing the number of hospitals on the list but of bettering the hospitals previously accepted. The minimum standard is constantly amplified in the administration of its details.

The ever increasing number of approved hospitals is a growing hope in the eyes of scientific medicine. Hospitals are surveyed not only in so far as they relate to surgical specialists, but from the standpoint of the entire medical profession and from the standpoint of service to the patient. The approved hospital stands for the stabilizing of ethical principles more than any other factor in medical organizations. Staff meetings do much to embarrass the occasional unethical member, who seeks more congenial associates where staff meetings do not hamper his loose methods.

The uncompromising stand of the College against the admission of irregular practitioners to the staffs or wards of approved hospitals has met

with unbounded approval and has done much to support the hospitals in resisting invasion by the unworthy. The qualified and ethical practitioner of medicine who is without special hospital affiliations now looks upon the approved hospital as his friend; and the health inventoriums that are conducted by many of our approved hospitals provide facilities for the family doctor that are of inestimable value to him and to his community of patients.

A SUMMARY OF REPORT—1918–1930

(1) 13 surveys of hospitals of 100 beds and over:
1918 692 hospitals surveyed
89 hospitals fully and conditionally approved
12.9 percentage approved.
1930 1433 hospitals surveyed
1334 hospitals fully and conditionally approved
93.1 percentage approved.
(2) 9 surveys of hospitals of 50 to 99 beds:
1922 812 hospitals surveyed
335 hospitals fully and conditionally approved
41.3 percentage approved.
1930 1001 hospitals surveyed
596 hospitals fully and conditionally approved
41.3 percentage approved.
(3) 7 surveys of hospitals of 25 to 49 beds:
1924 307 hospitals surveyed
49 hospitals fully and conditionally approved
15.9 percentage approved.
1930 730 hospitals surveyed
133 hospitals fully and conditionally approved
18.2 percentage approved.
(4) 6 surveys of government hospitals of the United States:
1925 100 hospitals surveyed
90 hospitals fully and conditionally approved
90.0 percentage approved.
1930 101 hospitals surveyed
101 hospitals fully and conditionally approved
100 percentage approved.

OUR RESPONSIBILITY AS FELLOWS TO THE HOSPITAL STANDARDIZATION MOVEMENT OF THE COLLEGE

C. Jeff Miller, M.D., New Orleans: The standardization, which has amounted to the reformation, of the hospitals of America under the leadership of the American College of Surgeons is one of the outstanding medical achievements of this century. In spite of the marvelous results which have been achieved, many problems still exist which must be solved, not only by the central office of the College but with the active participation of all Fellows. One of these problems concerns the quality of surgery done in hospitals wherein Fellows of the College practice.

Unfortunately for their patients, and equally unfortunate for themselves, in this country any graduate of a medical school who is legally licensed to practice medicine is likewise legally licensed to operate. It does not follow, however, that he is competent to operate, and this is particularly true of the young man fresh from his college and interne years.

The responsibility of granting those who are unqualified the freedom to experiment with human flesh and blood—for it amounts to just that—rests squarely upon the older staff men and particularly upon Fellows of the American College of Surgeons. To be specific—it goes without saying that a surgeon, if not in charge of an emergency service and if doing elective surgery, should be asked to explain an abnormally high death rate. A surgeon should be called strictly to account whose work consists almost entirely of cæsarean sections on flimsy indications, hysterectomies for equally slight causes, kidney suspensions, appendectomies for chronic appendicitis, etc. A surgeon whose operations last for hours, whose patients are routinely shocked, who has cases with postoperative hæmorrhages, postoperative infections, and aspiration pneumonias, is either exceedingly careless or exceedingly incapable.

It is not advocated that a hospital be a closed corporation, but more should be exacted of applicants for admission to the staff than their mere desire to be admitted. A firm stand should be taken against the admission of men, whatever their age and past experience, known to be incompetent or conscienceless, and equally firmly against promiscuous operating by young men rarely out of their medical 'teens, unless their work is done after consultation with and under supervision of more experienced surgeons. Surgical training such as recently outlined by Heuer of Cincinnati is beyond the reach of any but the favored few. The practical solution of the problem for the great majority, therefore, is the adoption, formally or informally, of the old system of apprenticeship. The day may be far distant, though surely coming, when legal restrictions will be placed upon the practice of surgery. Eventually requirements for admission to the College will include a clause to the effect that the candidate shall have served a surgical apprenticeship for a specified period under the tutelage of an experienced surgeon. The day may be far distant when formal restrictions can be placed upon the work of young men, but in the meantime results must be secured by sentiment against promiscuous, unsupervised operating, and by unwritten laws. One very practical method is the statistical review of hospital records. There is no fairer method of estimating either the ability or the ethics of any surgeon than by studying his output, both independently and in comparison with the work of others.

WHAT THE HOSPITAL STANDARDIZATION MOVEMENT MEANS TO THE PRESENT DAY PRACTICE OF MEDICINE

GEORGE W. CRILE, M.D., Cleveland: Standardization has brought together the hospital people, and has caused them to think and act more uniformly. By insisting on staff conferences standardization has brought together in harmony the physicians, also the administrative staff. Another point of importance—the standardization program has insisted upon hospitals providing efficient laboratories. Not that alone, but indirectly there has been growing up a profession of efficient persons to conduct these laboratories. Still another way in which the practice of medicine has benefited by standardization of hospitals is through insistence upon adequate clinical records. This has meant improvement on the part of all in the practice of medicine and greater accuracy in the treatment of disease.

The clinical research committees of the College, such as those on bone sarcoma and on fractures, have been stimulated and greatly aided by the hospital standardization movement through its provisions for better clinical records, better analysis of the clinical work and study of end-results. Altogether, there has been a rise in efficiency in the care of patients, and that influence has been exerting itself for a period of years and will continue to do so, so long as there is such an efficient organization as that presided over by Dr. MacEachern and his group to carry on the work of still further improving standards.

MY CONCEPTION OF AN IDEAL HOSPITAL

Rev. ALPHONSE M. SCHWITALLA, S.J., Ph.D., St. Louis: A conception of an ideal hospital which loses all contact with reality may be easy to describe but probably just as useless. It is in the sense of neo-idealism of today, which is perhaps not so different from the moderate realism of the past, that this problem is approached.

Can there be such a thing as an ideal hospital? What is ideal for the metropolis will certainly not be ideal for the intercounty institution. What is ideal for 1931 is not ideal for 1935. How, therefore, can the concept of the ideal hospital be described? The ideal hospital is the one in which the first, the controlling interest is at all times in every department the good of the patient. This thesis sounds suspiciously like a truism. And yet is it? In adjusting the difficulties of one kind or another which arise in the hospital how often is the good of the patient the primary consideration? The staff is disrupted. Over what? Too often because someone complains that a patient has been kidnaped, that an ambitious youth of a doctor has appeared to teach a time-tried generation the tricks of immaturity, that two bills were sent by two men where one man should have sent one, that a trivial mention in a trivial newspaper of a trivial event has been interpreted as advertising; for these and many similar reasons the staff may lose sight of the patient's good.

Hospital workers have organized into groups, each interested in promoting its own profession. But the only forward movement in such phases of hospital activity is the forward movement toward the more completely assured good of the patient. There have been suggested forward-looking policies which can and are successfully evaluated in terms of this criterion. New standards of sick room comfort, enforcement of a basic admission routine, the demand for a social history, and many other modern demands have for their focus the patient's good.

Concerning the medical care, the good of the patient demands a cautious radicalism and a progressive conservatism. The ideal hospital will facilitate progress in scientific research for its staff members by adequate laboratory facilities, by a free interchange of views in staff conferences, history meetings, and departmental conferences, and will encourage the fullest freedom of consultation independent of financial returns to consultants.

What is said of medical care is true of nursing care, which will be on the same level of progressiveness. Similar consequences follow concerning the educational functions of the ideal hospital, and the latter will regard the patient as its pupil. All of the educational factors will receive their full measure of attention; records will be kept up to the highest attainable level; insight into diseased conditions will be sought for through laboratory work and supplemented through carefully performed autopsies.

The social functions, such as participation in community undertakings and relations of good fellowship, will be stressed in the ideal hospital. Finally, there will permeate through the entire institution that keenness and that interest which distinguish the successful hospital from its mediocre neighbor. This is an achievable ideal. But no ideal hospital can be such without a master leader.

IS STANDARDIZATION OF SURGICAL TECHNIQUE POSSIBLE?

J. C. DOANE, M.D., Philadelphia: Standardization is a word which sometimes strikes fear and suspicion into the hearts of those likely to be

affected thereby. A long period of time must elapse before physicians and hospitals realize the good which might result from standardizing the number of internes and nurses, the type of staff organization and staff meetings. But is there no optimum method of preparing patients for the various types of operations, for draping patients, sterilizing hands and gloves? Perhaps because human brains and arms and fingers are in no two ways similar, so must each operation performed by one individual vary in many respects from that performed by another. If such an attempt to regulate pre-operative, operative, and post-operative procedures were possible, would it not be advisable from the standpoint of patients, doctors, and hospitals?

It would seem that a definite rule should be found on the roster of every surgical and medical department forbidding the transfer of patients to the X-ray laboratory for study before careful history and physical investigations have been made. How difficult is the enforcement of the basic requirement that urinalyses and chest examinations made within 24 hours shall be found on all pre-operative patients' charts?

Why in elective operations should there exist such a lust for haste? It seems difficult to rationalize a decision to operate in the presence of moist râles at both bases and a reddened throat when there is displayed at operation such attention to detail in carrying out the steps of the procedure itself. It seems unreasonable to go forward and unprotestingly accept 3 to 5 post-operative pneumonia deaths out of every 1,000 cases operated upon, as was the experience discovered in a recent survey of New York hospitals.

With the present knowledge concerning death following right upper quadrant surgery, is there any possibility of standardizing the preparation of these patients? If the use of dyes reveals the status of hepatic function, is there any routine study which should be required therefor? Can pre-operative, intravenous use of calcium and glucose be routinely practiced?

It is difficult to understand why in more hospitals the clinician does not routinely consult the internist and the surgeon the clinician in borderline cases. Would it be possible to have a standing rule enforced relative to securing surgical consultation whenever a case of typhoid is diagnosed, and would not the thyroid patient be much safer if examined by a clinician before operation? It has been intimated that the assignment of a surgeon to the medical department and a physician to the surgical department might work much good to the patient, as is the case in many hospitals. It would appear, however, that in more institutions daily conjoint rounds should be made.

It is most confusing to the average surgical ward supervisor to endeavor to remember which type of abdominal preparation the individual surgeon prefers. Surely there is no excuse for as many types as there are surgeons on the staff. Is there no effective method of preparing hands, of donning masks and gowns, of counting sponges, and draping patients? A leaf taken from the note book of a very efficient operating room supervisor in one of the leading hospitals showed that each of the 12 surgeons required a different method of preparation for his work. In another hospital 8 surgeons had 8 different methods of skin preparation. It would seem that time and money could be saved if some consensus could be reached as to the best and safest way to prepare the skin prior to operation.

The American College of Surgeons is to be greatly commended upon its recent attempt to standardize the method of preparation, sterilization, and counting of sponges. At the Jewish Hospital in Philadelphia the surgical staff has recently adopted a sponge count sheet upon which the operating room supervisor is required to certify as to the number of sponges she had at the beginning, the number placed in circulation, and the count at conclusion; and the surgeon is required to specify the fact that he called for a sponge count and was informed that all were accounted for.

While it is expected that the hospital will provide proper and sufficient instruments, it should not be asked to furnish a separate table for each type of surgery nor instruments rarely used. Though the hospital should not expect the surgeon to perform his work with unsuitable supplies and equipment, the possibility of the manifestation of just a trifle less individualistic an attitude on the part of surgeons is suggested.

If the American College of Surgeons could suggest methods by which pre-operative, operative, and postoperative procedures could be more definitely standardized, it would indeed be performing a great work.

Discussion

The speaker opening the discussion declared that patients are too often urged to take hospital rooms higher in price than they can afford, and stated that the kind of room the patient should have is in the hands of the attending doctor, since he is more likely to know what the approximate cost and length of stay will be. He urged that the

medical staffs of hospitals use standard supplies and methods wherever practicable, in order to reduce hospital costs.

In replying the next speaker said that the hospital preferred to put patients in rooms they were able to pay for rather than in those they could not afford. He urged that the patient be hospitalized only when necessary, and that fewer special nurses be engaged. Hospital Standardization was characterized as giving a new conscience to hospital trustees and to persons working within the hospital.

In the discussion of Dr. Miller's paper one delegate pointed out that his hospital, a teaching institution, had no difficulty in getting internes although they are not allowed to do major surgery in a one year rotating interneship. He advocated that hospitals seeking approval be asked whether or not they are allowing their internes to do major surgery without supervision.

A STUDY OF ACUTE APPENDICITIS FROM 1919 TO 1929 (INCLUSIVE) FOR THE PURPOSE OF EVALUATING THE BENEFIT FROM STAFF CONFERENCES

JOSEPH S. BALDWIN, M.D., Brooklyn: This is a résumé of 843 cases of appendicitis from the Greenpoint Hospital, Brooklyn. The operations were performed by the visiting staff, including associates, assistants and by the resident or house surgeon, always with the assistance of one of the visiting staff. Every angle of acute appendicitis was considered—age, sex, whether or not cathartics were taken, symptoms and their duration, pre-operative hospital stay, type of anæsthesia, operating time, pathological findings, type of drainage, culture reports, duration of hospital stay, complications, and causes of death.

It is to be noted, in agreement with previous studies on this subject, first, that the males predominate; second, that the great majority of cases are in the second and third decades of life; third, that extremes of age have the highest mortality; and fourth, that the mortality rate is lowest in the second and third decades.

The death rate varies from a high of 11.5 in 1920 to a low of 1.9 in 1925, the average being 6.8. This variation cannot be adequately explained except that the type of case treated evidently had something to do with it. The great majority of deaths were due to general peritonitis. The pulmonary complications were always associated with a general peritonitis and were undoubtedly a terminal process. Of the patients who died from general peritonitis, 7 entered the hospital with a history showing that the condition had been present and that abscess formation also was present. Five of these patients died within 24 hours after operation, one 3 days after operation, and one 9 days after operation. From an analysis of these cases it would seem that the expectant form of treatment might have given better results.

The last 5 or 6 years have witnessed a greater number of laboratory reports. The ratio in 1920 was 10 to the 53 cases treated, and in 1929 was 97 reports for 129 cases. Despite the increase in the total number of cases of appendicitis, drainage has been used to a greater extent. Ether is the anæsthetic of choice but spinal anæsthesia has been used increasingly during the last few years.

The average hospital stay for all cases was 20.5 days; for the 741 uncomplicated cases 16.6 days, and for the 102 complicated cases (those requiring more than 30 days' stay) 44.8 days. An explanation for the length of stay probably lies in the type of cases received in a city hospital. Eight hundred and forty-three patients were operated upon, and no drainage was used in 481. Wound infections of all degrees of severity were noted in 121 cases.

The most striking feature of this survey has been the marked improvement in hospital records, for they now contain all facts which should be a part of a complete history. This improvement in case records was noted directly after the institution of the monthly staff conference.

JOSEPH L. PFEIFER, M.D., AND WALTER J. O'CONNELL, M.D., Brooklyn: At St. Catherine's Hospital staff conferences have continued uninterruptedly since November, 1919, with the exception of the summer months and two sessions set aside as memorial meetings. In an attempt to evaluate the conferences, a study of acute appendicitis was undertaken which led to the following conclusions:

1. Staff morale has definitely improved.
2. Records are distinctly better as shown by more complete histories, more thorough physical examinations, improvement in nurses' notes; operative records are infinitely better but still leave much to be desired.
3. Co-operation, with closer integration of the pathology and X-ray departments, is an outstanding product of the staff meeting.
4. Consultations, both pre-operative and postoperative, have increased in number.
5. It is disappointing to note that the incidence of autopsies is low. In this group of 175 deaths, records of only 4 autopsies are found, a much lower percentage than the average for all deaths in the hospital.

Special conclusions to be considered are:

1. Pre-operative care. So far as could be determined, the pre-operative care was adequate. No patient was operated on without careful history and physical examination being recorded. Blood examination was made in every instance,

and when indicated further laboratory work was done, including X-ray examination to exclude pulmonary lesions.

2. Operation, including anæsthesia. Greater care has been exercised in the description of operative findings, noted more particularly in the later years of this study. Operating time shows little variation from year to year. There has been a slow but unmistakable tendency to adapt the anæsthetic to the patient.

3. Postoperative care. Progress notes show that patients have been followed with care and clinical alertness, and consultations have been more frequent. Not a single instance of postoperative neglect was detected.

4. Morbidity. The average hospital stay has varied little, from 16.6 for 1929 as compared with 18.9 in 1920.

5. Mortality. The death rate shows small fluctuations from year to year, with the most favorable showing of 3.1 per cent in 1929. The real significance of this cannot be determined; it may mean a year of unusually good experience or may represent a lower level of mortality. The fact that both morbidity and mortality for 1929 were below the mean for the decade may mean that future averages will be better.

If improvement is to continue it is believed the present organization and conduct of the meetings should be modified, that is, the staff conference committee and the hospital management will have to submit for consideration of the staff an annual audit of the mortality for the preceding year. The clinical records of the 175 deaths in this series are to be analyzed carefully and presented at a future staff meeting. The greatest hope of bettering conditions lies in group presentation and group study.

THE CO-ORDINATION AND INTEGRATION OF THE GYNECOLOGIC-OBSTETRIC SERVICE IN A GENERAL HOSPITAL

CHARLES A. GORDON, M.D., Brooklyn: That the specialist should be able to render special service a little better than anyone else needs no proof. While there is but little difference of opinion in the allocation of some physical conditions to a special field of surgery, the division seems not quite clear in regard to gynecology and obstetrics.

Since both gynecology and obstetrics are concerned with the function of reproduction in all its phases, the two should not be separated. Gynecology should not include surgery of the breast nor deal with any lesion not directly concerned with the process of reproduction. Surgery of the abdomen is constantly changing as is pelvic surgery, and because of special complexities the former belongs in the realm of the general surgeon, the latter to the gynecologist. The gynecologist must be a surgeon, but his work is not simply a specialized branch of surgery for he must have a thorough knowledge of obstetrics. The obstetrician must be able to cope with situations demanding surgical intervention. Abortion, extra-uterine gestation, hydatidiform mole, ruptured uterus, and the multitude of lesions following puerperal infection are his province rather than that of the gynecologist or general surgeon. Gynecologists should control or direct the irradiation of cancerous growths since radiotherapy belongs to the gynecologist and roentgenotherapy to the roentgenologist. Urology, surgery of the appendix, kidney, or gall bladder do not belong to the gynecologist unless frankly pathological conditions are discovered in the course of a pelvic operation.

The department should be under one head (subordinates rotating between the two specialties) and should function as one service. Provision must be made for consecutive call emergencies, yet they should be handled by the first staff member available. College affiliation is desirable. Attendance at general staff conferences, follow-up, social service, appraisal of end-results, and maintenance of out-patient clinics are also vital. Harmonious reciprocal relations are necessary between such a department and the others.

Illustrative of smoothly functioning departments of gynecology and obstetrics are those at St. Catherine's Hospital and at Greenpoint. During the last 12 years over 20,000 deliveries and a very large number of associated obstetrical conditions have been managed by the department of gynecology and obstetrics, with steadily diminishing friction and with constant growth of the department. Since obstetrics cannot function properly alone and since the general surgeon is not qualified to act as a gynecologist, it is desirable that obstetrics and gynecology be combined in the general hospital.

A PLAN FOR THE ORGANIZATION AND CONTROL OF THE COURTESY STAFF IN A GENERAL HOSPITAL

JOHN M. SCANNELL, M.D., Jamaica, New York: The perfection of organization of a courtesy staff depends largely upon (1) a proper relationship between the board of managers and the medical board with reference to professional staff appointments and (2) a real appreciation on the part of both groups of their responsibility to the community. The appointment of staff members by either group without regard for the wishes of the other is to be avoided. The agency of final authority in the matter of staff appointments, however, is the board of managers. As exemplified in the Mary Immaculate Hospital, the point of contact between the two groups is a frequent joint meeting of the executive committees of each, and, in addition, the chairman of the board of managers' executive committee is available for

the medical board meeting. There is no member of the medical board on the board of managers.

It does not seem that proof is needed to show that a community is better off with its entire group of perhaps 200 doctors having the privileges of a well organized hospital than when only 30 or 40 physicians have such advantage. In the case of Mary Immaculate Hospital it is certain that the 150 members of the courtesy staff are by such affiliation enabled to practice medicine the better and their patients are the recipients of better service. Nor have the members of the attending staff suffered in any way. Every ethical doctor should be connected with an approved hospital in his community; if not, he is likely to drift to a private sanitarium where scientific standards are generally low.

A plan initiated by the board of managers of Mary Immaculate Hospital provides that a doctor desiring to become a member of the professional staff make written application, stating qualifications, to the board of managers. Applications must be accompanied by letters of recommendation from two reputable physicians, and the applicant is asked to specify whether he desires membership with ordinary privileges, with privileges for dental surgery, or with special privileges. The applicant must also agree to be bound by the professional rules of the hospital, the laws of the Catholic church in relation to obstetrical and surgical practice, and the American College of Surgeons' pledge against fee splitting.

Membership with ordinary privileges gives the physician the right to use the hospital and its facilities for the practice of medicine and minor surgery, also for the care of normal obstetrics, including plastic repairs and minor surgical procedures. Membership with special privileges gives all ordinary privileges and the right to practice one of the following: removal of tonsils and adenoids; operations on the ear, nose and throat; operations on the eye; orthopedic operations; urological operations; obstetrical operations (all the major surgical procedures including cæsarean section); and major surgical operations. Each of these specialties constitutes a separate privilege and must be distinctly applied for and granted, except for the tonsil-adenoid operations, which are included under surgery of the ear, nose and throat. The privilege of major surgery does not include those of the other specialties.

Applicants for special courtesy privileges must qualify under one of the following classes: Fellows of the American College of Surgeons, attending surgeons in a recognized hospital, or physicians with the following qualifications:

1. Graduate of medicine for at least 5 years.
2. Interneship for at least 1 year.
3. Equivalent of 1 year's postgraduate work in gross pathology, surgical anatomy, and operative surgery.
4. A year of clinical assistance in the specialty applied for, a year of dispensary practice being accepted as equal to 6 months of clinical assistance.
5. A satisfactory personal operative record as certified to by the attending of the corresponding department after observance of the candidate's record.

In the case of tonsil-adenoid privileges, certification of a satisfactory operative record by the attending laryngologist is deemed sufficient.

Applications for courtesy privileges must be made in writing to the board of managers and referred to the medical board who recommends, rejects, or lists for continued consideration. No one except those who have been granted operating privileges, as mentioned above, may undertake major operative procedures even under supervision, but physicians not so qualified may act as assistants at operations on their own patients. The medical board decided that no surgical procedure is essentially and invariably minor, hence the ability of any staff member desiring to carry out some surgical procedure is referred to the surgeon on the service, not later than 24 hours before the operation is scheduled. Every 2 years the physician must make application for reappointment. Staff members are required to make clear their affiliations in all printed matter where their names appear, and particularly members of the courtesy staff must include this fact.

The plan outlined has been in operation for the past 4 years in Mary Immaculate Hospital, Jamaica, New York. From a practical viewpoint, although several members of the courtesy staff feel that this plan is too strict, the board of managers and medical board feel it is rendering the community a real service.

IS THE PRIVATE PATIENT GETTING A SQUARE DEAL?

JOHN E. JENNINGS, M.D., Brooklyn: The American hospital, striving still to be a refuge for the poor and the sick, to care for few or many private patients, to train a younger generation for hospital duties, to record properly the story of its work, and to keep abreast of science, finds itself urged to expand and faces a steadily rising per capita cost with a diminishing quotient of relief directly afforded to the sick poor. What more natural than to turn for help to an enlargement of the private pavilion? It seemed a fair working theory that the private patient should contribute his share to the support of the hospital and he is quite willing to pay all he can. The question is,

how deep is his purse? He may feel that he should not be taxed to support the ward or the educational activities.

It is very hard for a layman to believe that life is safer in the general ward, yet this is true. From the ward as a center radiates the sacred and serene responsibility, the vigilant authority that the sisters of Florence Nightingale maintain. In the ward occurs that strange metamorphosis by which the care-free medical student becomes the faithful, trusted house-surgeon and later the valued resident on the private side, and later still assistant, associate, and chief. Is it not true that inadequate ward service means failure to train junior surgeons, that it means lack of experience and courage in the house staff, and a gradual weakening in the nursing staff?

Discussion

Dr. H. L. Foss, of Danville, Pennsylvania, stated that The George F. Geisinger Memorial Hospital, a 200 bed institution, holds weekly staff conferences, except during August. The attendance record for 1929 was 92 per cent for the staff of 17 men. It is possible to make staff conferences so interesting that staff members cannot afford to miss them, the speaker said. The first portion of the staff conference at this hospital is given over to the presentation and discussion of 5 of the most interesting deaths for the week. The epitome of the patient's history is shown upon a screen. The doctors who studied the patient, the interne who took the history, the medical consultant, the surgeon, and the pathologist then give their report of the case in turn. Photomicrographs are shown and the organs, preserved according to the method of Lundquist of the Mayo Clinic are presented. Every interne is required to present once a year a paper covering some investigative work or original research.

REPORT OF THE STERILITY OF CATGUT IN RELATION TO HOSPITAL INFECTIONS

FRANK L. MELENEY and MABEL CHATFIELD, New York City, reported in full the results of their study of catgut (see p. 430).

IMPORTANT BASIC CONSIDERATIONS IN MAINTAINING AN ADEQUATE X-RAY SERVICE

EDWARD S. BLAINE, M.D., Chicago: No hospital can be regarded as properly equipped that does not have an X-ray department capable of serving patients and staff with adequate X-ray information. Such a department of an accredited hospital must be in charge of a physician roentgenologist. In establishing an X-ray department the floor area, the physical equipment, and the personnel should be considered in detail, the probable income of the department being kept in mind. An analysis of the gross X-ray incomes from a number of general hospitals discloses an average of about $120 per bed per year in the small hospital to $150 in the large hospital. This figure includes the income from out-patient or non-hospitalized patients. Based on the averages quoted here a normal expectancy of a 100 bed hospital (actual occupancy) is $12,000 a year and for a 500 bed hospital, $75,000 a year.

The problem is to provide space and equipment for X-ray procedures as follows: (a) exposures—roentgenography, (b) developing—photochemistry.

In the hospital of less than 50 beds the number of potential patrons is so small that there is little likelihood of producing a profit in such an X-ray department. Therefore, space as well as equipment must be kept to a minimum. At least one room of not less than 150 square feet and a smaller one of not less than 50 square feet should be provided. It would be better to set a minimum of 300 to 400 square feet for these two rooms.

The hospital of 50 to 100 beds should have a space of from 400 to 750 square feet to provide a room for combined X-ray exposure and therapy, a room for fluoroscopy, and a film developing room. The hospital of 100 to 150 bed capacity will need from 750 to 1,000 square feet of space divided into 5 rooms.

Hospitals of 150 to 250 bed capacity will require from 1,000 to 1,500 square feet, divided into 5 to 8 rooms; hospitals of 250 to 500 beds, from 1,500 to 3,000 square feet and from 8 to 12 rooms; hospitals with 500 to 750 beds, from 3,000 to 5,000 square feet divided into 12 to 16 rooms; hospitals of 750 to 1,000 beds, 4,000 to 8,000 square feet space assignment and from 16 to 24 rooms. The figures here given are to be considered as average requirements.

If the X-ray service be largely a mixed one it would be best placed on an upper floor convenient to the department of pathology. If it serves a large out-patient service it will best be located as near the hospital entrance as possible; if much accident and fracture work be done, near the surgical operating rooms. In the largest hospitals an entire wing should be assigned. Under no circumstances should the department be placed in the basement.

It is hardly likely that any outline could be written at this moment that would be correct for any but the briefest period of time because of the

constant changing and perfecting of apparatus. It seems safe to prophesy that sooner or later shock proof X-ray machines will replace standard equipment now in use. Another change in X-ray apparatus design points to the every day use of 100 milliamperes at upward of 100 kilovolts for ultra rapid film exposures.

X-ray installations for the smallest sized hospitals should have equipment that can be used for X-ray film exposures, fluoroscopy, light or superficial therapy. A hooded hand fluoroscope, Coolidge tubes and a tube holder, and a Potter moving grid which is part of a special X-ray table, together with intensifying screens, are desirable.

The hospital of 50 to 100 beds will need an X-ray transformer giving at least 140 kilovolts, together with a special combination fluoroscopic table with tube stand, Potter grid, and stereoscopic cassette shift. The 100 to 150 bed hospital will need a separate fluoroscopic equipment but this may be energized by the same X-ray transformer used for film exposures. The hospital of 150 to 250 beds will require separate equipment for X-ray exposure, fluoroscopy, and therapy. Hospitals of 250 to 500 beds require two separate equipments for X-ray exposure work and equipment for special diagnostic procedure, as well as added facilities for film viewing, additional tubes, screens, and cassettes.

It is best to figure on the enforced use of the acetate base safety film in spite of its increased cost over nitrate base films. Film wastage should not be countenanced, but reduction in the number of films made for diagnostic purposes will result in lowering the X-ray standards. In spite of the relatively high cost of screens, they must be replaced as soon as blemishes occur.

Average figures for installations in a number of hospitals shows that the amount is from $50 to $75 per bed in the large hospital and approximately $100 per bed in the small hospital, with a minimum of $5,000 for the smallest practical equipment, which sum includes all apparatus and office furnishings, but not the cost of radium or equipment for handling it. Operating costs for materials such as films, chemicals, tubes, and screens average about $25 per bed a year. Also to be figured in the cost of operating the department is depreciation, which should be estimated as at least 15 per cent per year of the original cost.

Since the smaller hospital usually finds it impossible to have a full time physician roentgenologist, a part time director is feasible in this event. The following personnel schedule is suggested for the various sized hospitals:

Less than 50 beds—part time roentgenologist, part time technician.

50 to 100 beds—part time roentgenologist, half time technician, part time stenographer.

100 to 150 beds—part time roentgenologist, full time technician, part time stenographer.

150 to 250 beds—quarter time roentgenologist, 2 full time technicians, part time interne, full time stenographers.

250 to 500 beds—part or full time roentgenologist, 2 technicians, medical assistant, an interne, a nurse, a clerk-stenographer.

500 to 750 beds—half or full time roentgenologist, 1 or 2 full time assistant roentgenologists, senior technician, 3 to 5 X-ray technicians, 1 dark room technician, 1 interne, 1 nurse, 2 stenographers, orderlies.

750 to 1,000 beds—full time roentgenologist, 2 or 3 assistant roentgenologists, senior technician, 4 to 6 X-ray technicians, 2 dark room technicians, 1 or 2 X-ray internes, 2 or 3 nurses, 2 stenographers, orderlies.

The compensation for the part time roentgenologist should be based upon the full earning power of the individual whose services are desired. The percentage basis of compensation, moreover, is productive of best ultimate results as it gives an incentive to greater effort. Experienced observers advise that it is best to base the return on gross rather than on net income. An optimum seems to be a third of the gross income. Compensation of assistant roentgenologists and other medical personnel often consist of a small salary increasing with each year of service, plus room, board, and laundry. Senior technicians who have unusual skill receive salaries of $200 to $300 per month.

AUTOPSIES, THEIR VALUE, AND CERTAIN FACTORS THAT WILL INFLUENCE THEIR INCREASE

B. Henry Mason, M.D., Waterbury, Connecticut: Autopsies are regarded as of so great importance to graduates during their interneship that hospitals showing a low percentage are not considered as desirable appointments.

It has been claimed that inaccuracy in diagnosis runs from 20 per cent to 75 per cent according to different authors. Going over the last 100 cases on which postmortem examination was performed at Waterbury Hospital, a gross error of 24 per cent in diagnosis was shown.

Admitting that it is desirable to secure as many autopsies as possible, what are the factors to be considered in an effort to increase the number? A general awakening of interest on the part of the medical profession, hospital resident, and internes, establishment of co-operation between the funeral directors and the hospital, and better quarters and equipment for pathological work are but a few of the factors which have brought at Waterbury Hospital during a two year period an increase in autopsies from 4 per cent to 40 per cent.

One of the most important considerations in obtaining permission for a necropsy is to have established such a cordial relationship with the patient's family that they believe the patient has had the best professional care and the most sympathetic treatment possible, hence are willing to co-operate in the request for an autopsy.

Illustrating the general apathetic attitude of clinicians relative to securing autopsies, 10 representative hospitals in southern New England, each with over 200 deaths the past year showed a number of autopsies ranging from 1 per cent to 46 per cent.

The question as to the proper person to ask permission has been answered in a few hospitals by appointing a single individual from the permanent staff with the idea that he would develop an unusually successful approach. At Waterbury, and in the majority of large hospitals, it is felt that autopsies should be obtained by the person in closest contact with the patient's family, as a rule the interne, or the family physician when the latter has had practically exclusive care of the case. The interne makes a careful explanation as to what constitutes an autopsy, and knowing that the first reaction is apt to be a refusal he is not discouraged. He explains that the body is not disfigured, that an autopsy is always beneficial to society at large and that tumors or other conditions may be revealed which will prove of valuable information to the family, and adds that a summary of findings is sent to the nearest relative. In case of failure he calls the resident and perhaps the visiting physician to talk with the family. Upon granting permission, the nearest relative signs a printed form providing for any restrictions requested by the family and these should be rigidly observed. The physician on the service is then notified, together with several other staff members, and notice of the autopsy is posted. Internes are supposed to attend all autopsies and each interne is assigned to assist at autopsies for a period of 2 months. There is a necropsy register showing date, name of patient, and names of physicians present.

A lack of consideration for the rights of funeral directors due to the manner in which bodies are handled often leads to an antagonistic attitude. To overcome such complaints a conference was arranged at which representatives from both general hospitals and the funeral directors of Waterbury were present to discuss technique to be observed in performing autopsies.

At this point attention is directed to an article by Arthur H. Chandler, entitled "Report of the Committee on Autopsies of the New England Hospital Association" which appeared in the *New England Journal of Medicine*, April 22, 1926. There is so much of value in it that it should be called again to the attention of those interested in this subject.

THE ABSORPTION OF SPECIAL CHARGES

L. C. AUSTIN, Milwaukee: In discussing this problem a hypothetical hospital containing 150 beds with 80 per cent occupancy is considered. On the basis of 10 days' average stay, about 360 patients would have been cared for per month. For an even figuring basis the per capita cost per day is placed at $6.00. Therefore the expenses for one year would be $259,200. The hospital has 30 private rooms which average $6.00 a day, 44 ward beds at $4.00, 15 ward beds at $3.50, 31 ward beds at $3.00, and 30 cribs at $1.50. These rates on a basis of 80 per cent occupancy will bring the hospital $157,096 in annual revenue, a sum that is about 60 per cent of the hospital's total running expense. It will be noted that of all the beds only 20 per cent of them are meeting the total cost per day and that with an 80 per cent occupancy there will be an actual loss in money. This shows an improper distribution of beds and is the reason why the hospital which has increased its total number of patients has usually not increased its income faster than its expenses.

From an analysis of 15,000 patients' accounts in the past 3 years it is found that out of every dollar paid by the patient he spends:

$0.60 for room,
.035 for nurses board,
.003 for telephone,
.074 for operating room,
.054 for anæsthesia,
.019 for drugs,
.021 for dressings and bandages,
.087 for X-ray,
.069 for laboratory,
.019 for delivery room,
.015 for physiotherapy, and
.005 for occupational therapy.

This shows that 40 per cent is spent for extras. But the fallacy of charging on this basis is that not every patient receives all the services enumerated. Particularly, it is a hardship on the private rooms which are already paying for their expenses.

If the patient were willing to pay the average cost of approximately $6.00 per day, the bill might be divided as follows:

$0.70 administration,
1.20 food,
.37 dietary,
.65 medical,
.58 housekeeping,

$.82 school of nurses,
.22 laundry,
.55 heat, light, and power,
.04 library,
.26 X-ray,
.38 laboratory,
.05 occupational therapy,
.06 physiotherapy,
.05 carpenters.

But here again the patient would be paying for something he did not receive. It will be noted that 38 cents is the cost per patient per day to run the laboratory. This amount multiplied by the total number of hospital days would give a total of $16,416 to run the laboratory for a year. Dividing this figure into room charge it is 11.5 per cent of the bed rate. Multiplying the amount taken from the patients per day for bed rates alone by 11.5 per cent will give $49.40, the return expected from the laboratory service to cover expenses. Using 12 per cent as a round number instead of 11.5 per cent and multiplying the bed rate charges by this sum we get a total of $60.18 from all the beds for one day for laboratory expenses. Figured on 80 per cent occupancy this sum becomes $48.14 or a total charge per patient per day of about 40 cents. This sum multiplied by the total hospital days per month would give you $1,440, just a bit less than expenses in the laboratory department. The system is now somewhat short of the goal intended, in that the patient in for 6 weeks might be continually paying for something he did not get. If the average days' stay of patients is 10, then arbitrate; increase the 12 per cent to 15 per cent, which will give $60.17 instead of the $48.14 mentioned above. This would give an average cost to the patient of 50 cents a day. Mount Sinai Hospital, Milwaukee, has such a plan, and since January, 1928, more than 14,000 patients' accounts have been handled with less than half a dozen complaints regarding laboratory charges.

A COMPARISON OF CERTAIN FACTORS ESSENTIAL TO THE SUCCESS OF A HOSPITAL

RALPH HUESTON, Joliet, Illinois: Financing of the hospital should be a divided responsibility, the administrator financing the operating expenses from receipts from patients' accounts, and the board of trustees financing all other expenses from other sources.

Two main sources of loss in the hospital occur in the system of charges to patients and in the purchase of supplies. Patients are attracted by a one price policy and also by a low bed rate. In order to maintain a low bed rate, each special department must be financed separately. The hospital can get a far greater revenue from the policy of a bed rate scaled as near cost as possible and a fair charge for all extra services than when it attempts to absorb all extras through a high bed rate policy. A definite scale of prices should be maintained. Exemplifying the fact that administrators of medium sized hospitals are often poor buyers, one hospital reports that in the first year after changing its policy, it showed an increase in general business of 10 per cent and a decrease in its cost of supplies of $5,700, the comparative saving being 16½ per cent.

The following is an example of how a 125 bed, standardized general hospital, operated not for profit, can maintain a high type of service at moderate charges and yet not show a financial loss. Four years ago this hospital was operating at 50 per cent of its capacity and at a deficit of nearly 10 per cent of its earned income where today it is running a daily average of 75 per cent capacity and operating at a profit of 6 per cent of its earned income.

Before reorganization, bed accommodations were 15 per cent for bassinets at $0.65 a day; 50 per cent for beds in wards ranging from $2.50 to $3.25; and 35 per cent for beds in private rooms from $3.50 to $6.00 a day. The average charge for all patients cared for (bed, board, and nursing) was $2.92 a day and for extras was $1.75 a day, not sufficient to meet the operating cost. Accounting records revealed that in one month, only 80 of 216 patients had been charged for drugs and dressings, although there had been 105 operations and 26 births during that period. A revision, making a fair charge for all such services, immediately showed several hundred dollars per month additional revenue.

Groceries had been purchased, without regard to competitive prices. Linen supplies were purchased from retail merchants at the retail prices less 10 per cent and frequently without the discount. Drugs, though ordered through a wholesale firm, were billed through a local retail drug store. These are typical examples of the purchase policies of many hospitals. Supplies, previously distributed from 7 store rooms, were consolidated into one, with a special room for drugs, a perpetual inventory system was installed, and one person made responsible for the store rooms. Laundry sent out cost the hospital about $1,000 a month whereas when its own laundry equipment was reconditioned at a cost of $235 and the laundry done in the hospital, an average saving of $500 a month was effected.

Factors in the low daily average of patients were lack of co-operation between departments, frequent changes in nursing personnel, inadequate

laboratory service, and inability to get co-operation of the administrator on routine procedures. During 26 months there had been 67 changes in the nursing department. In the 4 years of reorganization there have been only 9 changes and more than 50 per cent of the original personnel is still with the hospital.

The clinical laboratory which for 21 months previous to the investigation averaged $261.00 per month earned income, was reorganized at a cost of $2,700, a part time pathologist was employed at a salary of $3,000 a year, and within a few months the laboratory was on a paying basis. By the end of the first year it showed a substantial profit. New equipment was added to the X-ray department, prices were revised to meet recommendations of the medical staff and within a year its earned income had doubled.

Educational requirements in the nursing school were raised from a minimum to that of high school graduation, and affiliation for certain subjects was formed with other schools. A monthly meeting of the executive committee of the board of trustees, the advisory committee of the medical board, and the administrator was instituted as an aid in settling hospital problems and in establishing better co-operation among the groups.

When additional equipment required the expenditure of $10,000, this sum was met by raising the rates on 31 private rooms $1.00 a day, which met the approval of both doctors and patients since additional minor comforts were added.

An analysis of hospital records shows that during the third and fourth years of the new plan there was an operating gain of $4,502.83 and $10,711.30, respectively. There has been a gradual increase in the charges to a patient per day and a gradual decrease in operating expense of a patient per day. Charges for board, room, and nursing have increased from $2.92 to $3.39 a day and charges for extras have increased from $1.75 to $2.20 a day.

THE HOSPITAL'S TEACHING RESPONSIBILITY

JOHN E. RANSOM, Baltimore: There are some 316 teaching hospitals in the whole country, the staffs made up in large part of members of the faculties of the medical schools which control them. If one scans the worthwhile current medical literature he finds that a high percentage of it is produced by the faculties or staffs of these teaching hospitals. In most such hospitals there are at least a few men of outstanding professional ability whose attainments are such as to spur on the younger, less experienced staff members. But less than one per cent of the hospitals of America have this stimulating contact with undergraduate teaching. Though there is a large number of small hospitals that can do nothing to obtain such advantages, many private general hospitals of 100 beds or more could greatly enhance their value to the community by giving thought to their teaching and research opportunities.

About 4 years ago the writer became superintendent of an approved hospital in a community with no medical school. Because of the fact that it was to have a complete new plant, the time was propitious for a program to improve the service in all ways and to develop resources along educational lines. Among the first steps were the building up and maintaining of more definite X-ray and laboratory services, in which eminent success was achieved.

To stimulate interest in securing autopsies, weekly clinico-pathological conferences were conducted by the pathologist and a staff committee. These conferences have been attended by the more forward looking staff members and a goodly number of other physicians, and have had a marked influence in promoting better diagnostic work and more carefully written histories as well as developing the scientific atmosphere of the hospital.

While waiting for a research department to be built, a room was provided for animal surgery and physiological experimentation. The first research included a study of pulmonary and cerebral embolism, bronchial asthma and hay fever, peritonitis, intestinal obstruction and absorption from the kidney pelvis. Each physician had available some service from laboratory technicians, and the pathologist's collaboration was at all times an integral part of each investigation. A committee of the staff was organized, consisting of the pathologist, the roentgenologist, and one other appointed member to give direction to this investigative work. Should results warrant publication, the proposed articles had to be approved by this committee. As the result of the assistance of influential staff members, an appropriation of about $70,000 was granted to provide the additional space and equipment needed.

It was not expected to develop a research department that would lead to some spectacular discovery, but to provide facilities in the hospital where men who wished to do so could study and experiment quite as much, if not more, for their own development than for any contribution to medical science. Along with the inauguration of this investigative service and the clinico-pathologic conferences ward walks on both medical and surgical services were started. The percentage of

staff or charity patients was increased and departmental organization so developed that the work of the less experienced members could be better supervised.

Discussion

Dr. Meleney, answering questions put to him regarding catgut (see page 430), said that in the tests no evidence was found to show that of non-boilable, boilable, plain, or chromic catgut, one was more contaminated than another, but that it had been made a rule in their hospital to use only the boilable because in a series of infections that occurred non-boilable was the material used. He believes that chemical means of sterilizing non-boilable are less satisfactory than preparing it the same as boilable and then resaturating with moisture. He assented that each boiling of catgut does diminish its physical properties to some extent. For sterilizing the outside of catgut tubes he recommended Harrington's solution, the tubes to be in contact with it for at least 1 hour, preferably 24 hours. Asked as to whether he had any definite plans as to having some central organization control the manufacture of catgut, Dr. Meleney replied that he hoped the American College of Surgeons would agree to demand this standard test if it were satisfactory, of all catgut firms whose products the college approved. One speaker called attention to work of the new commercial standards division of the United States Department of Commerce which tests products guaranteed by manufacturers to come under commercial standards practice. The discussion concluded with a motion, which was carried, to record approval of the catgut test proposed and to request the proper committee of the American College of Surgeons that it take the suggested action.

Asked if it were advisable to permit free fluoroscopic use for the attending staff without supervision of the radiologist, Dr. Blaine stated that he considered this to be a dangerous procedure and thought it should be permitted only in the presence of one of the qualified technicians or the roentgenologist himself. One speaker declared that in 3 hospitals with 100 to 400 beds, the overhead during the past 5 years was more than 100 per cent of the primary cost of operating the department, this being actual cost of supplies and labor, exclusive of the roentgenologist's services. Qualified auditors found that the proposed distribution of gross earnings of the departments in two instances would have been excessive and would have resulted in a loss to the hospital. The speaker therefore recommended that before arbitrarily giving one-third of the gross earnings to the radiologist such a plan be verified by accountants. Dr. Blaine replied that though his figures showed a wide range, he failed to understand how the cost of operation should be 100 per cent.

In the discussion of Dr. Mason's paper, it was stated that disparity in percentages of autopsies obtained by hospitals was largely due to the fact that some included stillborns in the percentage, while others did not. On the basis that every case admitted to the hospital and dying there is part of the postmortem percentage, one hospital in which internes made all the contact with the family was able for a 5 year period to obtain from 76 to 84 per cent of postmortems. The percentage dropped to 74 per cent during the year the hospital changed its pathologist and failed to manifest interest in the interne's success in obtaining the postmortem. When interest was stimulated the percentage again increased. In reply to the query as to what extent the autopsy should be carried out, Dr. Mason replied that if properly done the autopsy ought not to mutilate the body, hence a complete examination should be sought if possible.

In response to the question as to whether patients receiving but one laboratory examination during their hospital stay object to the flat rate charge Mr. Austin repeated that there were few complaints once the scheme was explained to the patient. The compensation cases do not pay more than $8 for laboratory work regardless of how much they get. The pay patients in the hospital pay the expense of running the laboratory and the outpatient laboratory pays for all the charity laboratory work in the hospital, Mr. Austin stated.

Dr. Morrill spoke on the remuneration for radiologists and recommended that it be 50 per cent of the net earnings of the department, as an incentive to keep operating costs down. Referring to Dr. Mason's paper the speaker said that as a rule it is less difficult to obtain autopsies on private patients than those from the wards. In regard to absorption of special charges he said that the medical staff was more likely to oppose flat rates than were the administrators. In the speaker's hospital a plan is being considered by which one day's board rate for the average stay of 12 days is made the laboratory charge. Commenting on Mr. Ransom's paper, he said that as a means of utilizing its clinical material one hospital holds a monthly clinical day which is attended by staff members and other community physicians as well.

THE RELATIONSHIP BETWEEN THE GOVERNING BODY, MEDICAL STAFF AND ADMINISTRATOR IN HOSPITALS

E. M. BLUESTONE, M.D., New York City: Members of the governing board are responsible for the creation and maintenance of the hospital. They are also in actual practice a court of appeal for all matters of an executive, judicial or legislative nature within the hospital.

Hospital relationships with the patient must be adjusted to situations that are for the most part unprecedented. Decisions are, fortunately, with the governing board. One of the most important functions of this group is the selection of a competent staff. The duty of the board does not cease with selection, for staff members should be required by their conduct to prove their right to retain favored positions. With the appointment of a competent staff the board is called upon to provide facilities and equipment. Then there is the problem of limiting the stay of the patient in ward or out-patient department according to the duration of his illness. In planning for the care of the sick it must be remembered that the right to prescribe involves the obligation to follow-up.

How to strike a proper balance among the hospital's functions in the realm of preventive medicine, curative medicine, medical education, and medical research, can be solved largely by means of the medical staff and the governing board meeting in harmony through a conference committee.

The interest of the patient should be the criterion in guiding hospital relationships. It must be remembered that the social and medical exploitation of the ward ("charity") patient in this age is made easy by his poverty. Too often he is considered public property, whereas adequate medical service is his right and privilege as a self-respecting member of the community.

The hospital's educational obligation should include the general practitioner if we would avoid a vicious circle in which, deprived of the stimulus to higher medical knowledge, he becomes more and more out of favor with his more fortunate colleagues within the hospital. The resident staff should be ready at all times to serve its seniors in all work of a medical nature and the superintendent in administrative matters.

The medical board may be considered as the advisory body to the governing board in all things medical. In doubtful cases recourse may be had to public medical opinion outside the hospital, but not without the best of reasons. The question as to whether the medical staff is to serve on a full time (paid) or part time (voluntary) basis may be decided by the governing board, according to the economic status of the hospital.

In a very practical sense the key position in the study of relationships is the office of the director. He, besides administrator, is the co-ordinator of all hospital activities. If the administrator is a physician, so much the better, but the essential is his social spirit and understanding. There is reason for disappointment over the failure of our medical schools to place more emphasis on social medicine, and the opportunities for social work and medical organization such as hospital administration offers. Greater effort should be made by organizations like the Hospital Standardization Department of the College to train and to hold a competent group of administrators.

Discussion

Dr. T. D. Sloan, of New York City, stated that the report of the executive committee of the Trustee Section of the American Hospital Association in 1924 did much to clarify thinking on functions of hospital groups when it stated that trustees should determine policies, co-ordinate professional interest with community needs, maintain standards, direct the administration, and furnish support while controlling expenditures. Even though board, staff, and administrator have a common purpose, it is nevertheless necessary to exercise considerable tact to prevent friction in the working out of the various duties, he added. The trustees by their right to appoint the staff and the superintendent have the most favored position. Moreover, they can remove officers should the occasion arise, but this function is far more difficult to exercise.

Since the medical staff is the institution's greatest asset, attending physicians should be selected with extraordinary care. New members should carry the recommendation of the senior members, should meet the highest ethical and professional standards, and should show an ability to co-operate with other members. The attending staff should organize themselves into a medical board for the purpose of increasing their efficiency by concerted action and to advise the trustees in professional matters.

Regarding the relationship of the superintendent to the board and to the staff—the superintendent is the servant of both the board and the staff. He serves the trustees by acting as their executive officer in carrying out their policies. He carries with him the authority of the board and is responsible to the board. He is the liaison officer between trustees and medical staff, Dr. Sloan concluded.

THE RESPONSIBILITY OF THE MEDICAL STAFF TO THE ADMINISTRATION OF THE HOSPITAL

JOSEPH TENOPYR, M.D., Brooklyn: After the policy of the hospital has been formulated by the governing board, the execution of that policy must be left to the hospital superintendent, without interference, but he should be willing to receive advice from the medical board as a whole in medical matters. Relations of the medical board to the lay board should be through the superintendent. Matters of policy, if contrary to good practice, should be taken up by a joint committee of these two boards. It is not advisable to have a member of the medical board on the lay board.

The fact that the superintendent should have personal knowledge of the workings of all departments makes him or her the most responsible person in the hospital. The more power such persons have the more successful will the institution be, if they act wisely. Therefore, all requests should go through the superintendent's office. Since the medical staff will come in contact with the superintendent more than any other individual, such contacts on immediate matters should be made through the head of the various services so as to save the superintendent's time. The medical board should take up its problems of nursing, drug supplies, etc., with the superintendent at its monthly meetings.

Contributions of money to the hospital by members of the medical staff should not be acceptable to the lay board. The giving up of part of the doctor's fee to the hospital is a bad practice, simply another form of fee-splitting.

Instruction to nurses should be given by the medical staff but the training and discipline of the nursing group should not be a medical board matter except in an advisory capacity. Appointment of internes should be made by the medical board and not by individuals. Approval by the lay board should be a matter of form except where specific information of detrimental character is available. The interne schedule should be planned by the medical board, the executive head having charge of the internes in the medical board's absence.

So that the institution may function as a whole, monthly meetings of the medical staff should be held to discuss medical problems. Departmental conferences are to be encouraged but not in lieu of monthly general meetings. Lectures for the laity on health problems should be given at stated intervals under the direction of the staff. Research work is to be encouraged. As one of its first problems, the Department of Hospitals of New York City took up the question of exchange of doctors with foreign countries. Men connected with the staff of the department will be sent to Germany for not less than three months to act as residents and the Department of Hospitals of New York City will accept their men in turn. The medical board's relation to the medical profession of the community should take the form of clinical instruction of local doctors not connected with the hospital.

Discussion

Dr. Paul Keller, of Newark, New Jersey, said that one reason the medical staff is sometimes almost compelled to participate in medico-administrative affairs is the lack of expert direction on the part of the board of trustees and that this follows through in some respect to administrative officers. In business, in educational fields, boards of directors are made up of persons who understand the particular problems involved, but boards of trustees on the whole are men who have not been trained in hospital administration, he stated.

He believes that the boards of directors should appoint the medical boards and the executive boards, not upon the recommendation of the medical staff. If the board needs advice in this respect the medical administrator or the chief of medical services can be the adviser. After the executive medical staff is appointed by the board of directors, that committee should rotate each year. The duty of this committee would be largely that concerned with promotions, transfers from one service to another, expulsion of physicians, but not medico-administrative matters if it can be avoided.

In the general discussion which followed, one speaker stated that the superintendent could not get along without advice from staff members, but believed this could be secured in an informal way rather than by appointing standing committees for the purpose. Another speaker said he found, from years of experience, that harmonious results could be obtained with a member of the medical staff on the board of trustees and as a member of the executive committee. Dr. Tenopyr, in closing the discussion, said he felt that he had not been understood. He repeated that the superintendent is the chief executive but is to take advice from the medical board as a whole and not from one individual. Likewise the lay board is to meet with a group from the medical staff rather than with one man. He stated further that speaking for the physician, he had no desire to take part in the medical administration of the hospital but simply made requests for his needs to the superintendent.

THE RÔLE OF THE HOSPITAL BOARD IN THE SELECTION, APPOINTMENT, AND CONTROL OF THE MEDICAL STAFF

HENRY C. WRIGHT, Bath, Maine: The speaker's experience has been as president of the board of trustees of the Bath City Hospital, an approved institution of 50 beds. The staff of physicians and surgeons are residents of Bath and nearby towns and also associated physicians who enjoy the privileges of staff members, with the exception of not being permitted to vote nor to practice operative obstetrics or other major surgery. The staff members are privileged to call in any registered physician in good standing in any state.

Nominations to staff membership, which must be confirmed by the board of trustees, require that candidates be graduates of recognized medical schools, of good character and in good standing locally, that they be registered by the state board of registration in medicine and surgery, and that they abide by the hospital's rules and work harmoniously with the other staff members. It is wise to elect the new doctor to the associate staff for a year so that the quality of his work may be observed. Special appointments are made by the staff and confirmed by the trustees, and these appointees are full staff members, giving most of their time to the specialty.

The staff meets once a month for discussion of mortalities, unimproved cases, and improvements relative to the surgical and medical work of the hospital. As the trials and nervous strain of the staff are constant, it should be the object of every board of trustees to help rather than to hinder by arbitrary dictation. A good superintendent can do wonders toward lessening the burden of staff and trustees and preventing misunderstandings.

The control of the staff in a closed hospital presents fewer difficulties than in an open one, and the former type will certainly rate higher.

Discussion

Dr. C. W. Moots, of Mentone, California, said it should be borne in mind that the board of directors is supreme in all matters relating to hospital management, and that all physicians are agents of the board. But since most of the board members are laymen, they should be guided by an officer experienced in matters professional, the superintendent.

It may be necessary for the medical profession to be enlightened on the legal aspect of the question, he said. A kindly explanation of state supreme court decisions calling attention to the legal responsibility of the board for all things occurring in the hospital is sufficient to gain the support of the physicians. One state supreme court, in giving a verdict against the hospital, stated the only reason it did so was the fact that the board of trustees had not performed its duty, since the constitution of the hospital stated specifically that new staff members were to be appointed by a committee composed of members of the medical staff. It should be understood that either the constitution of the board or the by-laws of the staff must show clearly that staff appointments are to be made by the governing body. It is well to provide that appointments be made from a list submitted to the board by a qualification committee of the medical staff. Indifference on the part of individual doctors, which often results from too long tenure of office can be prevented by limiting staff appointments to one year, Dr. Moots declared.

THE RÔLE OF THE DEPARTMENT OF NURSING IN THE PROMOTION OF THE MEDICAL AND ADMINISTRATIVE AIMS OF THE HOSPITAL

MARIAN ROTTMAN, R.N., New York City: Nursing service is here defined as interpreted in the New York City Department of Hospitals. The nursing service of a hospital in this department is charged with the selection of both professional and nonprofessional personnel, the responsibility of assignments and schedules of duty, distribution and control of medical and surgical supplies, linen and patients' clothing, repair of apparatus used in bedside treatment, and instruction of all groups.

Ultimate responsibility is vested in the director of the nursing service, usually the superintendent of nurses. Any orders which the hospital superintendent desires to have the nursing staff carry out should be transmitted through the superintendent of nurses, and for the better management of problems relating to nursing service, daily conferences between these two officers are advised.

Adequate supervision must be provided so that orders may be properly executed. No authority has as yet set up a ratio of supervision, but a study of representative hospitals shows the following ratios: one assistant superintendent of nurses to every 225 patients or to every 75 nurses, either student or graduate; for bedside supervision, one supervisor to every 75 patients and one to every 25 student nurses or one to 40 graduate nurses. The general ratio of bedside nurses to patients in a general hospital was found to be 1 to 3 and in pediatrics, 1 to 2. A ratio of 1 to 2½ for general hospitals would more nearly meet the needs of patients and the medical staff.

Only those who can contribute to the morale and efficiency of the nursing service should be retained. Waste and abuse of supplies, heavy items in hospital economics, can be reduced to a minimum by supervision of ward personnel. With the increasing demands made upon the head-nurse, one woman can no longer be held responsible for service on her ward, and therefore the time has arrived for assistant head-nurses. Frequent inventories and checkups and a system of direct exchange, will make it possible to have well equipped wards and to trace waste. Repair of apparatus is best handled under repair requisitions from the head-nurse or personnel supervisor.

Since hours of duty add to or detract from morale, schedules must be given consideration though in times of emergency hours may be lengthened and duties increased.

One of the most important functions of the nursing service is ward housekeeping. The head-nurse should have supervision over maids and porters in her ward. In some well organized hospitals the housekeeper has charge of all ward housekeeping as well, but the principle of one or two persons trying to supervise too large an area argues against it. Though, routinely, housekeeping is not the duty of the nurse, she should understand perfectly its principles so that she may be able to fulfill such duties when occasion demands. The head-nurse is one of the most important persons in the organization.

THE DIETARY DEPARTMENT OF A MODERN HOSPITAL

MARTHA WALKER, Philadelphia: With the advances in medical science relative to nutritional disturbances, it becomes evident that the dietary department ranks with the pharmacy, the laboratory, and the operating room in saving life and affording relief from disease. The modern dietary department recognizes that the food requirements of the patient must not only be arrived at scientifically but the art of dietetics must be practiced in serving the food so as to please the patient.

This department plays a very important part in the instruction of patients, student dietitians, nurses and physicians with regard to proper diet. It may also purchase the food, or assist in this task. The dietitian must be familiar with the principles governing the purchase of food that will be economically sound, scientific, and practical. She must plan varied menus both for patients and personnel and must have an intimate knowledge of food chemistry. In many hospitals the dietary department furnishes a visiting dietitian to go into the patient's homes and instruct them in the purchase and preparation of food prescribed by the physician. Without this help the physician's advice is not productive of good results.

The dietitian must make a study of the various mechanical devices recommended for dietary departments and she should have a knowledge of housekeeping. She is also required to be well informed on the preparation of food and kitchen management and check on all food served so as to prevent waste. She computes daily the number of meals to be served and the supplies necessary so that no excess amount will be purchased. In addition, each day's market report must be gone over and foods selected for the next day.

The fact is acknowledged that adjusting food to the needs of most patients, keeping per capita cost within reasonable limits, and following market supplies are all more or less routine duties of the dietitian. It seems likely that if simple routine work is done as quickly as possible and the time saved is devoted to study of unusual problems, much good can be accomplished. As every patient is a guest of the hospital, he should have not only adequate food, but good food, well cooked and appetizing.

A better understanding of the dietary department on the part of physicians is needed, and many criticisms could be reduced if physicians would more frequently discuss their diet problems with the dietitian.

CENTRAL CREDIT BUREAU SERVICE FOR HOSPITALS

LEWIS S. GRISBY, Philadelphia: Realizing that credit and collection in the medical profession is not the regular merchandising practice, the office treatment of the individual case is handled according to personal circumstances. Yet why should the doctor or the medical institution suffer financial loss because of the high plane of patient-relationship?

Aid in centralizing information concerning the paying habits and financial responsibility is the purpose of the Hospital Section of this Bureau. Would it not interest the hospital to know that the patient who demands the most costly service, is never satisfied with it, and yet possibly insists upon remaining 3 weeks for a reason best known to herself, has treated two other hospitals in the same way and has not paid more than 10 per cent of the combined bills? To be practical in office methods does not detract one iota from the prestige of the professional person.

The National Retail Credit Association with international affiliations, headquarters in St.

Louis, a membership of more than 17,000 retail credit grantors and professional men, directs a service department of 1,150 official, responsible credit bureaus covering the United States and Canada. Pittsburgh, New York, and Philadelphia have professional sections for the work.

Member hospitals submit under secret, confidential code the names of non-paying patients. At regular intervals the bureau submits a confidential report that names listed are considered non-paying, a report that is made as often as members submit data. The member hospital is privileged to buy at cost plus handling any one of a series of 12 collection aids, carrying seal of the local bureau and the national organization. One of such services collected over $5,000 from retail profit and loss accounts in three months, summer of 1930.

THE COST OF HOSPITAL CARE

JOHN M. SMITH, Philadelphia: Though the quality of essential care in the wards is the same as in the private room or semi-private room, and despite the fact that most hospitals have all three classes of beds, human nature is such that many persons want service of a more luxurious type than can be afforded. While this type of patient may be paying installments on an automobile or electric refrigerator, it has never occurred to him to accumulate something to pay medical costs for the serious illness that eventually comes. To educate him to his responsibility is quite impossible because constantly more young people are growing up and must become somewhat mature before they can acquire the wisdom of thrift.

The states have passed workmen's compensation laws requiring employers to carry insurance to pay employees for time lost on account of occupational injuries and to pay hospitals and physicians for services rendered such patients. Recently there has been a tendency to have this insurance cover persons suffering from occupational diseases. As the next step these laws should be amended so as to require the employer to retain for the insurance carrier from the pay of each of his employees, a sufficient amount to cover the cost of insurance to pay for loss of time and hospital and physician's bills due to diseases and injuries other than occupational. This would mean that all employed persons would be automatically covered by such insurance by virtue of their being employed. The amounts provided for loss of income should be in an established ratio to the income, never equal to it. The amount for hospitals should be fixed by the state, the hospital and medical associations, and paid directly to the hospital or the physician. An approved list of hospitals, compiled by the state with the interested associations, should be provided from which the patient may choose. The employer or the insurance carrier must have the right of inspection of the patient and access to records. Such insurance could be carried with licensed companies or with a state insurance fund.

In addition, insurance companies should provide that for services rendered for hospitalization under the care of licensed doctors, payment shall be made direct to such hospitals and physicians. Such accident and health policies should be so worded that they are not as easily cancelled as at present and the usual list of allowable diseases omitted so that when patients are confined in hospitals there will be practically no exceptions other than obstetrical cases and those provided for by workmen's compensation laws.

Another way of providing for the care of the person in moderate circumstances could be through bequest insurance though this would not be effective so soon. Established companies are glad to write such insurance which provides that, following payments of a specified premium for a fixed period, the carrier will pay to a designated hospital a certain sum of money to be placed in its endowment fund, the income to be used to support the moderate priced service. As an inducement, the patient's hospital bills might be discounted while he kept up premium payments. To secure admission to said hospital the case would, however, have to come within the adopted rules of the hospital regarding types of cases accepted.

THE PATIENT'S IMPRESSION OF A HOSPITAL

J. H. SNOKE, M.D., Bryn Mawr, Pennsylvania: Are patients ever aware of the enormous amount of effort constantly put forth in their behalf? The average person has only a superficial knowledge of the clinical work being done for him. He does not know whether a thorough physical examination has been made, whether the latest surgical technique has been followed, and so on. He is no judge of the proper treatment clinically, even when such things are explained to him.

It follows then that a patient's estimate of a hospital must be based upon things he knows about—the attitude of the personnel, the food service, etc. Unless the patient is comfortable in mind as well as in body the most skillful treatment will not be fully appreciated by him and may lose much of its effectiveness.

Consider the state of mind in which a patient enters a hospital. He is not normal. He is about

to pass through a very trying and entirely new experience, hence his normal poise and control desert him. While in this frame of mind he is subjected to a list of questions. Often he is very slow about answering questions which to the questioner are perfectly simple, but the latter should remember that he has put such queries many times but to the patient they are entirely new. In many institutions kindly, quiet mannered people make this routine as little of an ordeal as possible.

If the patient is not dealt with kindly and justly in his view, the institution not only loses a friend, but makes a real enemy. What can be done to remedy such conditions? In many instances, having them called to attention will be sufficient. The first suggestion is to get the impressions hospital routine makes on patients. The administrator's own attitude toward these conditions and that of his staff will go far toward helping.

THE CENTRAL DRESSING AND SUPPLY ROOM

THOMAS J. RYAN, M.D., Philadelphia: Previous to the institution of a central dressing and supply room at Misericordia Hospital, a physician dressing cases would use 4 different trays with the services of 4 different nurses; the fact the trays were not uniformly prepared resulted in borrowing from other floors. Nurses were not uniformly trained in the art of preparing dressings and their assistance was not dependable. The hospital, moreover, was confronted with a large expense account for cotton, gauze, and adhesive. In October, 1924, the central system was instituted. All dressing trays, instruments, hot water bags, etc., were collected and an inventory taken. A graduate nurse was placed in charge of the dressing room and was allotted 5 undergraduate nurses who spent 10 weeks on each service, such as sterilization, dressing, cleaning instruments, etc. One graduate nurse served on night duty for 2 months.

This system immediately improved the dressing technique by centralizing responsibility for supplies. Should the physician wish a change in his form of dressing it is very easily accomplished by conveying his desires to the one nurse in charge. Intravenous trays are always in perfect condition, and every surgical dressing is done with the same technique. The required instruments, towels and gloves are packed and sterilized and are not used again until washed, boiled, and dry sterilized. With the good care resulting from central responsibility it is found that the best instruments may be secured.

To the surgeon visiting the hospital every day this central system is unusually gratifying as he simply calls the dressing room for a nurse who immediately answers with a dressing carriage and remains until his work is completed. His requests are carried out in detail, his day's work made lighter, the patient's stay pleasanter and shorter. The cost of supplying gauze, adhesive, cotton, and bandages to 16,677 patients in 1923 was $6,755.29 or $0.40 per patient while in 1925 the cost for 23,000 patients was $3,988.51 or $0.17 per patient. In 1929 the average was $0.16 per patient, and the average for all the years, excepting 1923, was $0.15½.

Discussion

In reply to questions on her paper Miss Walker stated that she believed a 200 bed hospital with 104 student nurses should have 2 dietitians. It was her opinion that a good dietitian could save her salary in laboratory and food. The dietitian should not charge a staff physician for arranging diets to be used by patients in their homes, she felt.

Questioning of delegates present revealed that food costs, including serving and overhead, varied from 18 cents to 70 cents a meal. A menu with a choice of food was suggested as a means of increasing the patient's satisfaction with hospital meals. The problem of keeping food hot was solved in one institution by a so-called portable cafeteria and the use of insulated containers.

The question was put to Mr. Smith as to whether soliciting past contributors for bequest insurance would not deter them from making current contributions, to which he replied that the insurance plan would be more successful in reaching persons who were not likely to be large contributors under ordinary circumstances. He urged that the community hospital conduct a financial campaign every 3, 4 or 5 years. Referring to compulsory insurance for all employed persons, Mr. Smith asserted that the plan was not revolutionary but merely another step in workmen's compensation.

It was pointed out in the discussion of Dr. Snoke's paper that kindly considerate persons to take the new patient to his room, carefully chosen orderlies, and helpful, courteous telephone operators would do much to create a favorable impression upon patients. Expressions were voiced in favor of the central supply room as a convenience and an economy.

HOSPITAL PROBLEMS ARISING OUT OF THE CARE OF HIGHWAY ACCIDENT CASES

EMIL FRANKEL, Trenton, read a paper on highway accident cases which is published in full in this issue (see page 561).

A NEW METHOD OF RECORD ROOM FILING

JOSEPH TURNER, M.D., New York: The following is an exposition of what a 3 years' test at Mount Sinai Hospital has demonstrated to be an effective and economical system for a hospital record room.

Somewhat previous to instituting the new system all charts were grouped according to disease and each service followed its own nomenclature. These were bound in heavy volumes at the end of the calendar year. The defects of such a system need not be enlarged upon. It is only necessary, for example, to point out that meningitis was to be found in all service classifications and therefore in as many volumes, and research requiring study of the records was so laborious as to discourage at the outset. Likewise, binding in volumes caused separation of patients' histories.

The new system aimed to provide easier handling and filing, to make the charts complete, to collect the life medical history of the patient in one place and in one binder, to develop a system of disease and operation nomenclature which would be complete, to settle definitions of complications, sequelæ, etc., to identify patients by ward and service, to provide machinery for statistical studies in any direction or in any combination and to do so without increasing personnel or cost.

It was decided to select a ready-made nomenclature which came nearest to meeting staff needs, one used by a number of Boston hospitals, which provided a cross index and permitted alterations and additions. At the same time, the traditional collection of histories into volumes by service and disease was abandoned and instead they were collated as unit histories, bound so as to permit change, and bearing the admission number.

A description of some of the printed forms used in the patients' charts may be of value. One of these, the patient's alphabetical index card, lists data which the hospital finds useful on admission of the patient and on the opposite side shows the diagnosis. A feature is the admission number which follows the patient all through the hospital and is the number by which the complete chart is filed. In case of re-admittance, the patient receives a new number and when he is again discharged, the new record is filed with all previous ones, the later number being placed on the cover of the folder and filed according to it. At the same time a blank cover sheet with the old number is placed in its former location with a note referring to the newer number and location of the chart.

While the patient is in the hospital, the alphabetical card stays in a small card index on the nurses' desk to serve as a current alphabetical list of patients on the floor. On discharge it is sent to the office with date for follow-up, and signatures of the attending and the house physicians added. The opposite side, containing the diagnosis, notes the condition of the patient upon leaving. Following the patient's final departure, this card accompanies the patient's chart to the record room.

Another printed form is the patient's number card which, except for the addition of name, service, and admission number, is a copy of the alphabetical card showing diagnosis, operations, and results. Filed numerically, it provides an easy method of referring back from the number to the name of the patient. The same result can be obtained by examining the charts on the shelves, filed by number, but the latter is more laborious. The card is also used in posting numbers of patients to their respective disease and operation sheet in the diagnosis index book to be described later. Where an autopsy has been made a brief summary of findings is made on this same card.

The clinical chart consists of the usual first history sheet, continuation history sheets, temperature, laboratory, X-ray, electrocardiograph, basal metabolism, anæsthesia, daily nurses' notes, and other special sheets. The first history has its genesis in the admitting room and is filled out in the same way and at the same time as the patient's alphabetical card is prepared and follows almost the same phraseology. Space is also provided for a succinct medical history, progress, results, and unusual features. The back is identical with the patient's alphabetical card. When finally indexed, bound, and checked, the chart is filed on the history shelf numerically. By referring to the alphabetical index, the number is obtained for reference to the shelves.

An open check list is kept in the record room as to daily admissions, to serve as reminder of incomplete charts. Likewise, the daily list of discharges is kept in the record room and is used to check charts, which must come to the record room the day after the patient is discharged. In case of the patient's death the chart must first go to the autopsy room.

The index of diagnoses is kept in a loose-leaf binder containing superimposed sheets in step formation so that name of the disease is clearly visible at the bottom of each one. On the sheets are listed the cases, according to admission number, which belong under a particular diagnosis. Cases resulting in death are listed in red ink. The diagnostic index is tabbed to correspond with the nomenclature book. Within are individual loose

leaves, one for each diagnosis and one for each operation in each section. Such data as the recorded diagnosis, the patient's admission number, name, service from which discharged, name of surgeon, and so on are listed. For detailed study the numbers refer investigators to the bound charts.

Since all cases of a particular condition, such as bronchopneumonia, are listed on one sheet, irrespective of other diagnoses that may have been made at the same time, physicians can readily study a single disease. Combinations of disease can be studied with equal facility by referring to the numbers, which, when they refer to the same page, show that a combination existed.

When the history and the patient's alphabetical card have been received in the record room the follow-up card is prepared. To note the borrowing of charts from the record room for follow-up or other purposes a "request for chart" card must be filled out and filed in the record room until the chart is returned.

THE ORGANIZATION OF THE RECORD DEPARTMENT

PAUL H. FESLER, Minneapolis: Every record in the hospital pertaining to a patient belongs in the record department, whether social, admission, financial, or other. The information clerks in the University of Minnesota Hospitals are engaged under the classification system of the University. They work with a budget; for instance, a single person earning $900 a year would be admitted to the hospital or outpatient department without question. If patients happen to come above the line of the budget they are referred to a trained admission officer, and if there is a social problem they are referred to the social service department. The social worker has nothing to do with the financial arrangements, but reports her findings to the admission officer who also happens to be a social worker.

Just below the main floor is the central record room and on the other side of it the central pharmacy. This is the only place where records can be found, or where prescriptions can be filled. Everybody must be kept out of the record room, with the exception of doctors for whom a special room is provided. Next to this room is a staff room for departmental conferences.

When a patient comes in for admission, records are checked to see if this patient has been in the hospital previously. In case of re-admission the old records are found and sent up to the record department. The doctor knows nothing about the patient's financial ability; this is coded to indicate the classification in the budget.

Each patient has a complete physical examination. In order to get good records it was necessary to have one doctor, who was paid by the administration of the hospital, to examine patients on admission. Under him are fellows, internes, medical students, and clerks. There are 20 small examining rooms, used as an admission department in the morning and medical dispensary in the afternoon. The interne makes an admission note with any statement desired as to diagnosis. He is not required to make a diagnosis but is expected to follow the patient through the service to see what happens to his statement of opinion.

Next to the admission department is the clinical laboratory and the X-ray department. The laboratories should be under the direction of one person. It may not be necessary in the teaching hospital but in most hospitals it would be. There is a room where internes do their work on the floor, also a small laboratory unit for them.

A most important part of the record is the progress note—the hardest part to secure. The interne should be responsible for seeing that these notes are made. The record librarian should be very much interested in seeing if a consultation was requested and promptly secured.

The most important single activity in connection with the development of good records is the clinical conference. Here a summary of the cases to be discussed is taken up two or three at a time. The most startling fact brought out from a group study of deaths from pernicious anæmia was that because certain chemical and laboratory examinations were not made in the records, very good data could not be obtained. Every record in this department is studied by the staff each week before it is filed.

In the record room there is a place for each doctor's charts. The internes, fellows, and the chiefs all have charts. When a patient is discharged the doctor must come to the record room and dictate his summary in the dictaphone. In order to get a good summary the staff member is required to write a letter to the doctor sending in every patient.

The hospital nomenclature is coded and the record punched accordingly. Thus if the doctor wanted all the patients with a particular disease, No. 11226, for instance, the cards would be placed in a machine and every card of patients with that particular disease would drop out.

THE CENTRALIZATION OF MEDICAL STATISTICS IN THE RECORD DEPARTMENT

MARY H. NEWTON, B.A., R.N., Pittsburgh: The advantages of centralization of records are to

assist the medical staff by relieving them of detail and making information on a particular patient readily accessible and to assist the institution by having in one place all information needed for reports, questionnaires, etc. The records department by being cognizant of the activities of all the other departments has aptly been called the index finger on the pulse of the hospital.

Information about the census of the hospital is obtained by means of a census sheet which each floor or division keeps for 24 hours beginning at midnight. These sheets, which contain the names of patients admitted, discharged, died, or transferred, are collected by the night supervisor who turns them into the general office where they are checked and then sent to the record department.

The record department receives each morning from the general office the cards for the patients admitted the previous day, from which are taken all data necessary for the patients' register. The cards are then returned to the general office for use in billing. When the patient is discharged the register is completed with diagnosis, condition on discharge, date of discharge, and file number. A record room card is also made out on admission of patients, with provisional diagnosis and operation, if any.

The operating room and delivery room make out slips for each of their patients with the name, surgeon or obstetrician, assistant, anæsthetic, anæsthetist, method of procedure used, and these are collected each morning for use in filling out the surgical register and birth book. A list of operations scheduled for the day is sent in each morning and the record stenographer writes up all operations which are dictated to her as the surgeon is closing the incision. These reports are checked with the slips from the operating room and the operations are then entered in the surgical register and on the card of the patient operated. The stenographer also writes the requisitions for pathological examinations of tissues.

In the emergency room there is a book of perforated sheets with carbons for reports on patients. If a patient is admitted to the hospital the report is sent to him so that the attending doctor may know what was done in the emergency ward. The remaining reports are brought to the record department each morning and segregated. If a patient had first aid only, a report is sent to the general office for billing but if he must return to the dispensary for further treatment a report is sent there. If the case is an industrial accident, a form letter is sent to the employer asking authorization for treatment and the first aid report is sent to the compensation clinic. Upon discharge of the patient, the report is filed in the record room.

X-ray films are filed in the record office in a steel case with outside vent and are cross indexed as to date, name, and view. Electrocardiograms are kept here and are listed according to the pathology. A card index of basal metabolic rates shows rates for the different dates and variations in weight, pulse, blood pressure, and date of thyroidectomy, if any. Each of these departments sends monthly reports to the record office listing the number of various examinations and treatments. When a diagnosis of infectious disease is made, the interne reports it to the record department and it is in turn reported to the city, which necessitates that the statistician keep informed as to municipal laws.

The matter of consultation requests has caused the staff some difficulty. We have now instituted a rule which provides that the physician in charge fill out a consultation request that is attached to the patient's record. The interne or the nurse immediately telephones it to the record room and it is our responsibility to see that the consultant is notified as soon as possible.

Each year the medical staff sends a list of their members, with their associates and assistants and the months they will serve. In case of a change of service it is the duty of the record office to notify the men who are coming. Likewise, a list of interne changes is sent to the departments. Each interne keeps a record of work he has done and these cards are turned in to the department weekly. Dispensary records come under supervision of the records department just as those of the hospital and a monthly report of the work done is rendered.

Birth certificates from the obstetrical department are checked over before mailing them to the city, and the date of mailing is entered in the birth book. The medical statistician must be familiar with the exact rules of the Bureau of Vital Statistics so that the death certificates will be filled out properly.

THE RÔLE OF THE STUDENT NURSE IN THE CLINICAL RECORD

MARY MERRILL, Williamsport: A chart is the doctor's most important means of reviewing the condition of his patient between visits. But a great many doctors completely ignore charts because they know that the information contained in them is exactly the same as it has been for several days.

One of the main factors to be considered when charting is differentiation between symptoms

which are always present in a case of the kind for which the nurse is caring, and those which are new and unusual. General symptoms are the basis for correct diagnosing and unusual ones predispose to complications.

It frequently happens that the nurse carries out all treatments very precisely but her powers of observation are not cultivated enough for her to note the effects of such treatment. Therefore, when the doctor reads the chart he notes that the treatments were given but no reaction is stated. Statements recorded should be brief but should contain all information necessary to enable the doctor to judge the patient's condition. It is unnecessary to chart routine work such as "morning care," "regular diet." But just what the patient ate is important. "Dressing changed" is meaningless, but information as to the discharge, the appearance of the incision, antiseptics used in cleansing the wound, etc., are valuable notations.

Although it will be no small task to impress students with the necessity for a complete, concise chart, the latter type can be written just as easily as routine ones.

CASE RECORDS AND CLINICAL CONFERENCES

IRVIN D. METZGER, M.D., Pittsburgh: Great clinicians and surgeons have advanced because they studied not alone each case as it appeared, but also because they collected data by systematic records of cases so as daily to amplify their own knowledge as well as that of the profession in general.

One of the virtues of case records lies in the fact that notation of an idea helps to stabilize it. Furthermore, successful hospital care of patients today means co-operative work. The pathologist, the radiologist, the anæsthetist, the dietitian and other hospital aids must have at hand accurate data secured by others in order to serve intelligently. Because of their gravity, hospital cases frequently necessitate interdepartmental consultations. All these factors demand careful records.

From experience as inspector of hospitals the following observations relative to case records have been gleaned:

1. The record pack should contain all the essential printed forms, in separate sheets, which the type of case requires.

2. Notations should be clearly legible, written in ink in long hand. Typed records though quickly legible, lack fixation of responsibility and the vital interest of first-hand script.

3. Historical and physical examinations when noted in the records should be concerned only with fact finding. If taken by an assistant they should be carefully read and corrected by the chief before tentative diagnosis is noted. All should be signed by the clinician making the record and countersigned by the chief immediately after he has verified the same in conference with his interne.

4. All orders must be written and signed by the chief or by his assistant at his suggestion. No nurse should be expected to execute unwritten orders. Telephone orders should be given to the resident or interne and noted by him and likewise all inquiries from the chief concerning the patient should be made of the physician responsible for the case during the chief's absence.

5. Progress or clinical notes should be made daily if possible. They should record any significant clinical change, should be consistent with the orders, and give a sane reason for any change in treatment, likewise they should be consistent in themselves and portend the ultimate outcome of the clinical course.

6. In closing the record upon discharge of the patient at least three considerations should be noted:

a. General condition of the patient, observed after a thorough examination upon discharge.

b. Condition of the part treated in a concise statement rather than in such obsolete terms as "improved" or "unimproved."

c. Disposition of patient as to further treatment and instruction as to time he shall report for care.

7. Requisitions for special investigations and for consultations should be made on special sheets, should delineate the suspected ailment and provide room for reports. The latter should be signed by the person responsible. The order for the special examinations should be clearly written by the chief.

8. Records should be frequently inspected at the bedside by a specially trained clerk to keep them up to date and to see that they are complete before the patient is discharged. Shortly after, they should be examined by a record committee selected by the staff from among its members.

9. Records should be carefully indexed and cross indexed for future reference.

10. Laboratories, likewise, should file copies of their reports and specimens of their investigations.

Such a detailed system of records may require the addition of a clerical staff but is fully compensated for by the consciousness of having essential data well in hand.

In the clinical conference we get the higher viewpoint which brings out individual cases in their proper relation to the totality of knowledge relative to them. All cases which have puzzled the clinicians, should be frankly presented and criticized. Every case, upon admission should be considered as a potential subject for investigation in these conferences; hence records and research notations should be complete, exact, comprehensive, and worthwhile.

DISCUSSION

Discussion of Mr. Frankel's paper (see page 561) brought out suggestions for aiding the hospital to collect from accident cases, such as dealing directly with the attorneys rather than with the patients, filing a lien as soon as the patient enters or leaves the hospital, and enactment of

compulsory insurance laws in all states. Mr. Frankel pointed to the need for further study of the problem by organizations such as the American College of Surgeons and the American Hospital Association.

In the discussion of clinical records it was urged that the patient be seen by a doctor as soon as possible after entering the hospital. It was likewise stated that leaving completion of the history and physical examination records to as late as 24 hours after admission was not desirable. A plea was also made for better follow-ups. The unit system of keeping histories seemed to have the preference, according to a tally of methods used by representatives present.

ROUND TABLE CONFERENCE

Conducted by Robert Jolly, Houston, Texas:

It was agreed that clinical records should not be allowed to go out of the hospital except when subpœnaed, or occasionally on written permission from the doctor and the patient.

The consensus regarding the problem of getting physicians to attend clinical conferences when their cases were to be taken up was that some one person other than the physician responsible should be appointed to give the synopsis or open the discussion on every case.

Regarding the problem of payment for blood transfusions, representatives of two hospitals, one large, the other small, stated that they paid donors $25 for every 500 cubic centimeters and $5 for every additional 100 cubic centimeters, and that being on a full laboratory service there was no charge for the test or for the administration. In a 200 bed hospital a flat fee of $25 was charged the patient, which the donor received if the patient was able to pay.

By way of economizing in the hospital it was suggested that a permanent, well paid personnel would be a factor. Other means offered were a chart showing the price of all supplies in the hospital so that the personnel would be impressed with the cost of material wasted or broken; a central storeroom from which is issued a sales slip for every article so that the charge for each ward can be totaled for comparison at the end of the month; the employment of a purchasing agent to be responsible for buying and disbursing of all materials; the securing of competitive bidding in the purchase of supplies; and the employment of an engineer to reduce the cost of repairs and heating.

To increase hospital income it was suggested by one speaker that the educational expense be separated from the rest by having no training school in the private hospital, by asking the school board to be responsible for nurse education in city hospitals, and by having church hospitals conduct their nurses' schools as they do their other schools. A study of 10 hospitals made by one speaker showed, however, that the total cost taken in terms of the patient, per capita, was $2 a day for the 6 with training schools, and $2.53 for the 4 hospitals with no training schools. To the objection that graduate nurses have been found expensive or unsatisfactory it was stated that the fault lay in employing them on the same basis as student nurses, such as permitting afternoons off.

Concerning direct revenue to the hospital, aside from that derived from charges to patients, it was found to be secured by popular subscription, from charitable organizations, from a type of insurance fund allowing contributors a specified number of days hospitalization yearly if needed, from patrons' funds, from business and professional organizations, from tag day sales and benefits. It was agreed that medical staff members should support the hospital they serve by sending their patients to it. The growth of the small, unsupervised hospital or nursing home, lacking in control of the staff, was pointed out as a pressing problem. A boarding service for diabetic patients, a drug store in the hospital, health examinations and diagnostic clinics were recommended as other means of increasing hospital revenues. One speaker warned, however, that flower shops, barber shops, and drug stores installed in hospitals placed such institutions in competition with business. He suggested that if all community hospitals gave the service desired by physicians no need would exist for private institutions. It was pointed out by another speaker that some private hospitals, particularly in the South, hold regular staff conferences, have good records and in general have higher standards than other local institutions.

The question of the charge for medical service to staff members and their families, hospital personnel, and the clergy was brought up and it was shown that the range was all the way from free service to a discount of 20 per cent or less. The trend of opinion was that if a nurse becomes ill she should be allowed to choose her own doctor, but from the hospital staff, with the provision that her family doctor be allowed to see her.

One hospital representative described a plan of nurse interneship by which the nurse who has just graduated enters a rotary service as preparation for the position of supervisor. In another institution a postgraduate course was given 2 hours a

week for 3 months, from the standpoint of administration.

It was urged that all staff appointments be made yearly and that every doctor sending patients to a hospital should have some unit part in the medical staff organization and meet its qualifications. As a further aid to harmonious relations, members of the courtesy staff should be invited to attend clinico-pathological conferences and other special conferences, and to use the hospital records for their studies. Consultations in the hospital should be limited to members of the active staff it was stated.

In closing the meeting the Director of Hospital Activities for the College stated that the courtesy staff member should be given an opportunity and be required to present before the staff conference his own cases resulting in death or other untoward conditions. He stressed the need for frankness as a means of settling hospital problems, stating that sound organization would do much to prevent misunderstandings and controversies.